126055

JPRS-CST-87-013

2 APRIL 1987

China Report

SCIENCE AND TECHNOLOGY

WHITE PAPER, No 1

FBIS FOREIGN BROADCAST INFORMATION SERVICE

2
369
A16

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

JPRS-CST-87-013

2 APRIL 1987

CHINA REPORT

SCIENCE AND TECHNOLOGY

WHITE PAPER, No 1

Beijing ZHONGGUO KEXUE JISHU ZHENGCE ZHINAN [CHINA SCIENCE AND TECHNOLOGY WHITE PAPER] in Chinese No 1, Aug 86 pp I-236

CONTENTS

/6091

PREFACE

[Text] With the approval of the State Council, the State Science and Technology Commission has decided to publish successively the CHINA SCIENCE AND TECHNOLOGY GUIDEBOOK (Science and Technology White Paper) and the GUIDEBOOK FOR SPECIAL FIELDS (Science and Technology Blue Book) in order to provide direct information to the ranks of scientists and technicians and the people throughout the country on the principles and policies of scientific and technological work and measures pertinent to certain major specialities formulated by the party and the state. It is an important move to strengthen the macroscopic guidance of scientific and technological work throughout the country.

The reason that correct policies constitute the basis of our successful pursuit of the socialist modernization program is because they conform to China's reality, follow world development trends, and reflect the desires and long-range interests of the scientists and technicians and the people of the whole country. The categories of modern science and technology are numerous, while the specializations followed by China's 10 million-plus scientists and technicians differ in thousands of ways, each with his own orientation and goal. Within a given phase of social development, restricted by such conditions as resources and finances, the orientations and goals determined by each individual are often mutually restrictive as well as promotive, and possibly at times conflicting. As shown by practice, without policy coordination, even if everyone works extremely hard, it is inevitable that departments, specializations, offset each other, making results contrary to expectations and wasting valuable manpower and financial resources. Only with the guidance of correct policies and under conditions in which the essence of policies is mastered by the majority will the vigorous struggles of the millions of scientists and technicians and the activities of the hundreds of millions of people parallel one another without conflict, complementing each other, converge into a mighty torrent and produce the best social results. This is the primary purpose behind publication of the science and technology white and blue papers.

Any given science and technology policy is the product of a given historical period. It strives to reflect the national conditions and popular will and the world development trend of the time. With the progress of science and technology and the development of society, the current policies must be continuously revised in order to adapt to the changes. Since the goal of

formulating and implementing any given science and technology policy is to coordinate the direction of scientific and technological activities in diverse fields, differentiate the importance and urgency of the work of certain departments or specializations, readjust the orientations, and expand or reduce the scales of development, it is very difficult for each and every department and each and every individual to recognize fully the necessity of the particular policy. Moreover, nothing in the world is perfect. It is impossible for any policy correct for the overall situation to be flawless, and certain limitations are inevitable. Thus, the science and technology policies in force in each and every period are collected and published for testing by means of objective practice and for hearing and assimilating the ideas of scientists and technicians and people of the whole country, in order to preserve the essence and discard the flawed, and to continuously supplement, revise and perfect. This is another reason for publishing the white and blue papers.

The Science and Technology White Paper offered to readers today records and expounds the essence, bases, and implementation of major policies formulated by the party and the state since the Third Plenum of the 11th CPC Central Committee. It is divided into six parts: Part I, "Historic Transition," discusses in general the basic principles and strategies and the reform of China's current scientific and technological system. The remaining parts are: Part II "Policies and Legislation," Part III "Research and Development," Part IV "Commercialization and Technological Achievements," Part V "Environment and Resources," and Part VI "Statistical Indicators." The final portion consists of selections of important speeches of central leaders and important documents of the party Central Committee and State Council.

After the Third Plenum of the 11th CPC Central Committee, our party and government, for the first time in the history of our nation, elevated science and technology to a foremost position. It was a great awakening of the nation. Without scientific thinking, it will be impossible for us to stand tall in the world. Without scientific and technological progress, there will be no advanced socialist material and spiritual civilizations. Correct policies serve as the most important guarantee for science and technology to promote effectively economic construction and social development. Like the nozzle of a rocket engine, they focus the energy emitting from the scattered endeavors of tens of millions into a gigantic directional force and propel the takeoff of our economic and social developments to new heights.

Song Jian

Member, State Council
Minister in Charge, State Science and Technology Commission

PART I. HISTORIC TRANSITION

CHAPTER 1. FUNDAMENTAL POLICY GUIDELINES IN THE NEW HISTORICAL PERIOD

[Text] As our [national] cause continuously progresses and develops with the guidance of the correct principles and policies of the Central Committee and State Council and the effort of the people throughout the country, so, too, science and technology can only advance along a correct orientation to achieve planned goals and tasks under the guidance of the central government's principles and policies.

Since its founding, China, in different historical periods and according to the needs of economic and social developments of the time and the scientific and technological capacity and developmental trend, has successively proposed specific principles and policies for scientific and technological development.

After 1978, the focus of the party's work shifted to economic construction, and the role of science and technology in economic and social development won increasing appreciation. The Party Central Committee and State Council progressively and clearly proposed a comprehensive basic policy on the development of science and technology.

In his speech at the National Science Meeting in March 1978, Comrade Deng Xiaoping expounded the fact that science and technology are productive forces and that scientists and technicians are a part of the working class, discussed such important issues as improving the party's leadership over scientific and technological endeavors, upheld and further advanced Marxism, and laid a reliable ideological foundation for a basic policy on developing science and technology in the new period.

The National Scientific and Technological Work Conference held in December 1980 focused on China's policy on scientific and technological development, and the "Report Outline" written after the meeting was approved by the Party Central Committee and State Council in April 1981.

At the 12th National Party Congress in 1982, Comrade Hu Yaobang reiterated in his political report that scientific and technological modernization is the key to the four modernizations, and clearly proposed for the first time in our party history that science and technology are one of the strategic focuses in building the national economy. The status and role of science and technology in the modernization program thus became even clearer.

At the National Science and Technology Award Meeting in October 1982, Comrade Zhao Ziyang, on behalf of the Party Central Committee and State Council, gave an important speech on "A Strategic Issue in Developing the Economy," and incisively expounded the strategic guiding ideology that "economic construction must rely on science and technology, and scientific and technological work must be geared to economic construction." It is the basic policy for China's socialist modernization program as a whole, including science and technology.

We must rely on science and technology to quadruple the total industrial and agricultural output value by the year 2000 and progress to the achievement of modernization. It will be impossible to achieve quadrupling on the basis of old technology, equipment, material, techniques and products, but possible on the basis of new technology, equipment, material, techniques and products. If we do not rely on science and technology, we run the risk of not attaining our goal. Relying on them, we are assured that the goal will be reached. Thus, industry, agriculture, all trades and professions, new and old plants, and enterprises of all kinds and types must focus on the link of technological progress, and purposefully, step by step, shift production to a new technological basis. Therein lies China's hope for the achievement of the four modernizations.

Scientific and technological work must be geared to economic construction, and scientists and technicians must plunge into the grand undertaking of the socialist modernization program, especially economic construction. The range of scientific and technological work is broad and the tasks numerous. First, they must study the crucial problems affecting major economic results in economic construction. They should make contributions in all aspects, and the most important is to contribute to the improvement of production technology and economic results.

Specifically, gearing scientific and technology work to economic construction includes five aspects:

(1) We must develop science and technology in coordination with the economy and society, making the promotion of economic development our foremost task.

Modern science and technology widely permeate all aspects of the economy and society and constitute a powerful force to promote economic and social development. Their impact is no longer confined to the application of specific technological achievements item by item on production. Though such impact is extremely important, modern science, as an intellectual system, is exerting a growing influence on the economic and social policies of the state. Therefore, in addition to economic construction, science and technology must serve all endeavors in society as well as the building of a spiritual civilization. However, as economic construction is the focus of the party's work and the most important link in the development of the nation as a whole, science and technology must make the promotion of economic development the foremost task.

(2) We must stress research in production technology, select the appropriate technologies and form a rational technological structure.

After 36 years of effort, China now possesses the capacity to overcome problems. However, when it comes to production technologies exerting a broad influence and widely used throughout the national economy, these technologies have seldom been improved or upgraded. While the flaws in economic systems and policies have contributed to the situation, failure to give proper attention and full support to the study and development of production technology in scientific and technological work are an additional factor. In terms of the allocation and use of scientific and technological strengths throughout the country, we should, for a fairly long time to come, stress the study and development of production technology. When selecting technologies, we must, instead of the unilateral pursuit of the newest and most advanced, start from China's actual need and feasibility, select suitable advanced technologies, and gradually progress from manual labor to semi-mechanization and semi-automation, and finally to mechanization and automation.

(3) We must strengthen the work of popularizing achievements in science and technology on the frontlines of industrial and agricultural production.

For a long time, technological strengths on the frontlines of China's industrial and agricultural production have been weak, and the rate of popularizing and applying scientific achievements has been fairly low. Besides fully developing the roles of existing technological strengths in enterprises and rural areas, research organs and institutions of higher learning should actively support scientific and technological work on the frontlines of production, and scientists and technicians should be encouraged to volunteer for frontline posts. Also, we should vigorously advocate and properly handle the transfer of scientific achievements from the laboratory to production, from advanced regions to backward ones, from the coast to the interior, and from military use to civilian use.

(4) We must ensure the gradual development of basic research on a stable base.

Basic research is an essential part of scientific and technological work, and is significant in increasing scientific reserves, exploiting China's unique natural resources and training a new generation of personnel. However, in view of the fact that the study and development of China's production technologies urgently need improvement, while our current investments are limited, we can only gradually increase investments some in basic research on a stable base. As the cycles of basic research are often fairly long, we must maintain stability and continuity and guard against rash and perfunctory acts.

(5) We must regard learning, digesting and assimilating foreign science and technology as an important way to develop China's science and technology.

As shown by the experiences of many countries, skillfully assimilating and digesting foreign achievements will greatly conserve investments, shorten the

course of technological development and promote the growth of China's technical forces. It would be both foolish and impractical for us to start from scratch in everything and create our own. We must organically integrate the study of foreign achievements with our own research, combine import of technologies with digestion and assimilation, and truly attain the stage of developing and innovation on the basis of digestion and assimilation.

"Economic construction must rely on science and technology, and scientific and technological work must be geared to economic construction." The proposal of this basic policy indicates that China's scientific and technological work has embarked onto the road of close coordination with economics. The policy correctly handles the coordination of science and technology with economics and society, properly arranges the relations between basic, applied and developmental research, and solves the series of fundamental issues involving the development and popularization of production technology, determination and selection of technological structures, and correct approach to advanced foreign achievements, and places China's scientific and technological endeavors on a firm foundation.

The current task is to develop more successfully the roles of science and technology and turn them into powerful productive forces and a truly gigantic power promoting economic development. To develop fully the roles of science and technology in the national economy, we must give special attention to the popularization and application of scientific and technological achievements and properly handle the four transfers:

(1) From the laboratory to production. Through the years, China has made numerous laboratory achievements, which are assets already in hand. Only by transferring them to production and solving the problem of practical application will it be possible to enhance their impact on economic construction and gain the proper results.

(2) From exclusive military use to joint military and civilian use. China's military industry is equipped with fairly advanced technology and equipment and superior personnel. Transferring them to appropriate civilian branches and sharing them between the military and the civilian will bring benefit to both.

(3) From the coast to the interior. In China's coastal areas, industry is relatively developed and technology fairly advanced. Transferring the advanced production technology of coastal areas to the interior and frontier regions is an important means to stimulate the development of the national economy as a whole.

(4) From overseas to inside the country. In recent years, China has imported many advanced technologies from abroad. If we can focus on digestion and assimilation and make some innovations, we will produce significant economic results.

The basic policy has won the enthusiastic support of the vast number of cadres and people on the scientific and technological and economic fronts throughout

the country and engendered an unprecedented vitality in China's scientific and technological endeavors. From the central to local governments, party and government leaders of all levels throughout the country have strengthened leadership on scientific and technological work, and the vast number of research units and scientists and technicians have further clarified the basic goals and orientation of development and enhanced their sense of responsibility and consciousness in rendering service to economic and social growth. As a powerful productive force and an effective means of policy-making, science and technology are playing increasingly important roles in practical life. Among such encouraging changes, the most obvious is the rapid growth of integration of science and technology with economics. According to statistics, the rates of popularizing scientific and technological achievements in the various areas and departments have generally shown marked increases. In the past 5 years, the number of scientific and technological achievements winning state awards for their major economic results grew on a large scale, with 1982 showing a 24-percent increase over 1981, 1984 showing a 40-percent increase over 1983, and 1985 more than double that of 1984.

6080/6091
CSO: 4008/7

CHAPTER 2. DEVELOPMENT STRATEGY IN THE SEVENTH FIVE-YEAR PLAN

[Text] One distinctive characteristic of the Seventh Five-Year Plan in China's national economic and social development is the focus on science and technology, basing the growth of China's economy more firmly on scientific and technological progress.

Whether the numerous momentous issues confronting China's economic construction can be effectively solved hinges on major breakthroughs in science and technology, and whether its economic development can amass a powerful reserve strength is also deeply rooted in scientific and technological progress. Naturally, it is impossible to solve the numerous scientific and technological problems confronting us within a short time, and a protracted, unrelenting effort is needed. The most important thing today is to spread the strategic viewpoint of giving serious attention to science and technology so that all quarters will feel a sort of urgency in their acceleration.

The strategy for scientific and technological development in the Seventh Five-Year Plan can be classified into four aspects under two major categories. One category is directly oriented toward today's economic construction and serves the goal of quadrupling output. It is the primary task of scientific and technological work and the main battlefront of most scientists and technicians and research organs, and we must uphold this correct orientation without the least vacillation. Serving the development of the national economy at the end of this century and the beginning of the next, the second category belongs in the realm of long-range explorations, to be performed by only a small number of scientists and technicians. In the work of both categories, we must earnestly organize task forces, and vigorously develop, exploit and spread scientific and technological achievements producing good and fast results. The contents of the four aspects are as follows:

1. This aspect includes the transformation of traditional industries with new technologies and creation of systematic and complete scientific and technological capacities for the transformation.

At present and for a considerable period hereafter, traditional industries serve as our base. China plans to achieve an annual total industrial and agricultural output value of 1.6 trillion yuan by the year 1990, and realize a total state revenue of 1,119,400,000,000 yuan in the coming 5 years, mainly from traditional industries. The technological level and production

capacity of traditional industries are the lifeline of China's economy as a whole. Thus, under the capital construction policy for the next 5 years decided by the central government, the state will channel the main investment (around 50 percent) to the technological remolding and expansion of existing industries. The primary task of China's science and technology is to launch technological remolding of traditional industries, properly perform the work of technological exploitation and the digestion and assimilation of imported technologies, and provide enterprises with suitable advanced technologies and equipment, including high-tech equipment.

In conjunction with reform of the scientific and technological systems, we must readjust and organize a group of research organs, with complete systems and the capacity for digestion, assimilation and development, to serve mainly the technological remolding of such basic industries as energy, communication, and materials and traditional industries with relatively weak technological strengths such as farm products processing and food processing.

By the end of 1985, the State Council had already approved technology policies in 12 fields. We must continue to formulate policies reflecting the trend of modern technological development and that suit our needs in various trades and professions, in order to guide the course of their progress. We must give special attention to the remolding of basic components, equipment and technology, and strive to achieve the integration of machine and electronic technologies, in order to guarantee quality, reduce cost and enhance results. We must build a group of intermediate industrial experimental bases for communal use by enterprises of the same types in technological remolding, and closely link research with production.

2. We must act according to our capabilities, selectively exploit high technology, and render service to the creation of new industries.

The flourishing high technology is producing a major and profound influence on economic development and human progress. The United States, West European countries, Japan, the Soviet Union and East European countries are all making the exploitation of high technology the main theme of their political strategies. As China's current financial resources are limited and its technological level low, and the relations of its various systems are not yet properly adjusted, it is difficult to make high-tech exploitation the foremost task. But we must not resign ourselves to remaining behind. We should adopt the policy of priority developments and limited goals. We will select microelectronics and information technology, biotechnology, and new materials technology as the main targets of our endeavor, deploy suitable strengths to strengthen high-tech research and exploitation in space technology, laser technology and marine engineering, and gradually create a number of new industries.

We must formulate unified plans, integrate technology with trade, vigorously import advanced foreign technologies and management methods, effectively organize the strengths of research and exploitation units and enterprises, integrate imported technologies with domestic research and exploitation, and develop and innovate on the basis of digestion and assimilation.

By means of economic measures and necessary administrative means, we should encourage independent research units and pertinent enterprises to form combined organizations, in order to create a group of technology-intensive industries with a high capacity for digestion, assimilation, exploitation and production.

In the realms of high technologies already selected, we must determine a group of priority projects and concentrate forces on their exploitation, especially those involving large investments and intense difficulties, which require an even higher concentration of forces. In terms of tax, credit and management, we will adopt a number of special and preferential measures on their behalf.

3. We must vigorously develop and spread the use of complete technologies and serve the development of regional economies.

Vast in area and abundant in resources, China's countryside has a population of 800 million and more than 100 billion yuan in funds. In recent years, rural township enterprises have grown rapidly, and their 1985 output value totaled 230 billion yuan. At the present momentum, the annual output value will reach 1 trillion yuan by the year 2000, and the rural economy will become a decisive factor in China's national economy as a whole. Moreover, the growth of township enterprises will absorb local manpower and avert the migration of rural population to large cities, possibly opening a path for rural development with Chinese characteristics.

Nevertheless, the problems generally found in today's local and rural enterprises are backward technology and serious shortages of technical strengths and equipment. With the approval of the State Council, the State Science and Technology Commission, together with the departments concerned, is in the course of implementing the "spark" plan, focusing on a group of technological exploitation projects requiring short cycles, producing fast results, and suitable for medium and small-sized enterprises, in order to support, guide and equip them. Under the plan, some local research units are given support and, exclusively serving local and rural enterprises, they have as their main assignments the exploitation and popularization of suitable technologies and the development and copying of technological equipment. Meanwhile, research units under the various central departments are requested to give serious attention to the development of suitable technologies, earnestly sort out existing achievements, form into a complete system all those which can be used to develop the local economy, and promptly transfer them to local enterprises.

4. We must render more support to applied and basic research that has a far-reaching influence on the development of the national economy.

One important characteristic of modern science and technology is the ever shorter cycle of their conversion into technological commodities. In some fields, basic research, applied research and technological exploitation almost develop in parallel. The moment a theoretical achievement is made, it is rapidly developed into technology and applied in production. We must give special attention to theoretical research of this type.

China's priorities for the development of theoretical and applied research include the following: Projects having a major significance in the long-range development of the national economy and production technology; those producing a major effect in the exploitation and utilization of China's dominant resources; those with strong research strengths and the potential of making breakthroughs in the near future; those tending to increase important scientific reserves; and so forth.

Accompanying the growth of the national economy, state allocations for science and technology will increase annually. In addition, with the reduction of support to technological exploitation units, we will, in such forms as science funds, increase allocations for important basic and applied research. Meanwhile, the state will remold and build a group of laboratories and improve the conditions of basic and applied research.

We will further bring out the special skills of veteran scientists, while selecting and training a group of outstanding young personnel to reinforce basic research and form and consolidate competent contingents.

During the Seventh Five-Year Plan, while fully recognizing the importance of science and technology in economic construction, serious attention must be given to their roles in building a spiritual civilization.

First of all, we must fully recognize the important significance of science and technology in building a spiritual civilization. Scientific and technological knowledge and their theoretical systems are the important base for the birth and development of Marxism. They are themselves an important part of spiritual civilization--the part which is relatively stable, full of vitality, and making rapid strides. The level of science and technology is an important yardstick of the level of the spiritual civilization of a nation and the forces propelling it forward.

Next, we must develop the roles of science and technology in each and every aspect in building a spiritual civilization.

1. It is obvious that science and technology provide spiritual civilization with modern technological means.

2. Science and technology promote and propel the development of Marxism and sociological theories. We must adopt measures and vigorously promote the close integration of research in natural sciences with that in social sciences, and strive to change their long-standing severance from each other.

3. Science and technology assail and change obsolete social concepts. In China, the components of traditional culture and feudal ethics of thousands of years are fairly numerous, while the components of science are relatively few, and many social concepts formed thereby will undergo tests and criticisms in the new development of science and technology. Thus, spiritual civilization of the socialist era must take advanced scientific concepts as its cornerstone, and never serve as the fence protecting obsolete concepts.

4. Science and technology must spread and develop scientific spirit and methods. The purpose of scientific research is to seek new knowledge, remold existing techniques and conventions and create a future. Any serious science worker must possess a realistic and innovative spirit, which must be widely spread and developed in building a spiritual civilization. In addition, the various methods of combining quantitative and qualitative analyses in general use in research are also indispensable in building a spiritual civilization.

5. Science and technology must fight ignorance and superstition. One important issue in building a spiritual civilization is the struggle against ignorance and superstition. Today, China still has over 200 million illiterates, few people receive higher education, and the scientific and cultural qualities of many remain low. If we fail to improve the scientific and cultural levels of the people throughout the country and widely popularize scientific and technological knowledge, it will be very difficult for a modern spiritual civilization to take root among the masses.

6080/6091
CSO: 4008/7

CHAPTER 3. TOWARD A NEW MANAGEMENT SYSTEM

[Text] In recent years, China has been exploring and experimenting on the reform of scientific and technological systems. Subsequent to the "Decision of the CPC Central Committee on the Reform of the Economic System" formulated by the Third Plenum of the 12th CPC Central Committee, the "Decision on the Reform of the Scientific and Technological System" was made in March 1985, thereby including it in the party's important daily agenda and giving it a foremost position on the scientific and technological front.

The reform of the scientific and technological system is an urgent requirement for development. With the spread of the new technological revolution, science and technology are permeating ever more deeply all realms of society's material and spiritual lives and serve as an important cornerstone in building a modern spiritual civilization as well as an important source in improving labor productivity. Many countries in the world today, including the Soviet Union, the United States and Japan, are studying the reform of scientific and technological systems. If we fail to pay close attention to work in this aspect, we will mishandle the overall situation, block the development of science and technology, and widen our gap with world advanced levels. In terms of China's current scientific and technological systems, they were formed under specific historical conditions. Though it has been demonstrated that we can concentrate forces to solve certain major problems, the systems are growing ever more incompatible with the demands of modernization. The main flaw is the maladjustment between research and production, making it difficult to gear scientific and technological work to economic construction and to spread and apply scientific and technological achievements promptly, and fettering the wisdom and creative talents of scientists and technicians. Many scientists and technicians and management cadres deeply feel that they are unable to utilize fully their strong points and work with a free hand. Meanwhile, the technologies in many fields of production are extremely backward, and science and technology encounter many difficulties in developing their roles. In terms of the demands of economic construction today, rural reforms have aroused the tremendous enthusiasm of the vast number of peasants to apply science and technology. One can anticipate that, with the intensification of economic reforms focusing on cities, the demands of all quarters on science and technology will exceed those in rural areas. For this very reason, the issue of the reforming of the scientific and technological system is growing more obvious.

To reform our scientific and technological system, we must clarify the guiding ideology. The CPC Central Committee has time and again declared that the work of all branches and all fronts must closely rally around modernization and quadrupling output. The reform of scientific and technological systems must do likewise and serve the core, and firmly uphold the guiding principle that "economic construction must rely on science and technology, and scientific and technological work must be geared to economic construction."

The orientations and goals of the reform of the scientific and technological system is consistent with the reform of the economic system. Precisely as stated by Comrade Deng Xiaoping, "reforms of both the economic and scientific and technological systems are for the purpose of emancipating productive forces. The new economic system should be conducive to technological progress, and the new scientific and technological system should be conducive to economic development. If we work along both lines, a relatively satisfactory solution to the maladjustment of science and technology with economics will become possible."

The main substance of the reform of the scientific and technological system is: with regard to operational mechanisms, we must change the appropriations system, expand the technological market, and correct the unilateral reliance on administrative means to manage scientific and technological work and the excessive and rigid control by the state. While implementing the planned management of key state projects, we must apply economic levers and market forces in order to give science and technology organs the capacity for self-development and the vitality to serve economic construction on their own initiative. In organizational structure, we must change the situation leading to the separation of an excessive number of research organs from enterprises, the dislocation of research, planning, education and production, and the severance between the military and the civilian and between regions. We must vigorously strengthen the capacity of enterprises to assimilate and exploit technology, rapidly transfer technological achievements to the intermediate links of production, promote cooperation and coalition between research organs, planning organs, colleges and universities, and enterprises, and rationally deploy the scientific and technological strengths of all fields. With regard to the personnel system, we must overcome the "leftist" influences, put an end to the situation of excessive restrictions on personnel, absence of rational flow of talented personnel, and lack of proper respect for mental labor, and create a favorable environment for the emergence of competent people and the full use of their abilities.

As the reform is aimed at changing habitual activity patterns, organizational structures and certain ideas and concepts, the degree of difficulty can be imagined. However, the reform pursued by us, in line with the world trend and compatible with China's reality, has won the enthusiastic support of the vast number of scientists and technicians and people throughout the country. In recent years, especially in terms of the 1985 reform of the scientific and technological system, the orientation has been accurate, the pace safe, the progress sound, and the results obvious.

First of all, by studying the CPC Central Committee's "Decision," the vast number of scientists and technicians and cadres has gained a relatively clear understanding of the main flaws in China's scientific and technological system, and the significance, goal and tasks of its reform. Only with such a consensus will it be possible to adjust the orientation.

Precisely as pointed out by Lenin in the early days after the October Revolution, the important thing is that the channel has been opened. The CPC Central Committee has also declared time and again that the key to reform is to correct the orientation of progress, and not to seek to go fast in the beginning.

Second, in implementing the CPC Central Committee's "Decision," the various areas and departments, in conjunction with their own specific conditions, have formulated many concrete measures and regulations, facilitating their gradual fulfillment.

Third, the reform of the scientific and technological system has indeed made actual progress. What is uppermost on the minds of the vast number of scientists and technicians and units is how to make contributions to the modernization program, and their most active work sites are found in enterprises, rural villages and markets urgently in need of science and technology. Right at the start, the reform is like a magnet, attracting the vast number of scientists and technicians and units, and propelling them to shift from the development of science and technology per se to making a contribution to serving economic construction. It is a fundamental change in direction.

The reform of the scientific and technological system in 1985 stressed four aspects, all producing marked results.

1. A change in the appropriations system. While central and local science and technology appropriations have increased somewhat annually, we have given attention to the different types of research and begun to adopt different methods of appropriation, in order to solve the problem of relying on state funds for all research work. By the end of 1985, among the 3,700-plus technological developmental research organs at the prefectural and city levels and above, 1,900 implemented the technological contract system, an increase of 20 percent over 1984. Of these 3,700 organs, 317, or 8 percent, achieved total economic independence and no longer need state funds. By means of transferring technology, rendering service to society and developing new products, their total revenue reached 780 million yuan, more than double that of 1984. Moreover, the science fund system began to be experimentally introduced for basic and applied research organs and, by means of evaluation and selection and support by units in the same field, the Chinese Academy of Sciences and the State Seismological Bureau allocated funds amounting to 170 million yuan to more than 4,400 research projects. In terms of the developmental work on fast-changing and relatively risky new technologies, the State Science and Technology Commission has formed the New Technology Pioneering Investment Corporation in their support.

2. Opening the technology market. To solve the problem of free transfer of technological achievements and in order to promote commercialization, large quantities of technological achievements poured into the market in 1985 and were sold like other commodities. According to statistics, the 1985 total trade volume in the technology market throughout the country was 10.86 billion yuan, a 13-fold increase over 1984. Due to the tight money market and bank loans, by the end of 1985, the real effective trade volume was 2.3 billion yuan.

3. Enhancing the capacity of enterprises to assimilate and develop technology. All research organs, on the basis of voluntary participation and mutual benefit, were encouraged to form joint organizations of all types with enterprises, including joint development, joint operation and integrated research and production entities, in order to remedy the weak technological strengths of enterprises and the maladjustment of research with production. By the end of 1985, 24 percent of research organs throughout the country had established fixed horizontal links with enterprises and created over 9,700 joint research and production organizations, almost 4 times greater than 1984.

4. Changing the personnel management system. In 1985, a change from the technical title system to the technical post appointment system was experimentally introduced in some units. According to statistics on the 39 experimental units under 6 central ministries and commissions, this measure involved over 32,000 scientific and technical personnel. After the change, the number of senior personnel (associate professor and above) increased from 4,500-plus to 8,000-plus, and a group of junior personnel was promoted to mid-level and senior posts. It indicates that the appointment system is conducive to stimulating the enthusiasm of scientists and technicians. In 1985, a new situation in the flow of personnel also emerged. The outflow was 40 percent higher than the inflow in large cities, and 30 percent higher in medium and small-sized cities, while the inflow was 60 percent higher than the outflow in rural areas. This indicates the rational direction of personnel flow and its necessity and feasibility.

According to the central government's policy of "consolidation, digestion, supplementation and improvement," the reform of the scientific and technological system stresses two aspects in 1986: the comprehensive introduction of the reform of the appropriations system, and the general implementation of the professional post appointment system. If the former, a continuation and improvement of the reform in recent years, is not properly handled, it will be difficult to consolidate the achievements already gained. The latter is an important supplement to the 1985 national wage reform. In terms of the scientific and technological communities, as the measures involve the funding of thousands of research organs and the vital interests of tens of millions of intellectuals, they are matters of concern to everyone. If properly handled, it will greatly stimulate the enthusiasm of scientists and technicians, but the least bit of carelessness may create problems. Thus, we must be conscientious, cautious and meticulous, and proceed steadily.

The reform of the scientific and technological system is one of society's complex systems engineering projects, and it is difficult to solve many problems in isolation. The rate of progressively reducing the operating expenses of research units, for instance, involves issues of economic policies, and some departments, because of their impatience, have created difficulties for some research units. The lack of clear limits in certain policies and the lack of consistency from beginning to end in some regulations have made it impossible for many technological contracts to be performed and trade agreements to be honored, thereby affecting the growth of the technological market. Thus, the reform of the scientific and technological system must be coordinated and synchronized with the reforms of the economic system and other realms and made mutually promotive.

6080/6091
CSO: 4008/7

PART II. POLICIES AND LEGISLATION

CHAPTER 1. PROMOTE SCIENTIFIC PROSPERITY

[Text] Since the beginning of the 20th century, major breakthroughs have been continuously achieved in scientific research. Mankind has made a new leap in the cognition of nature and its laws. Developments in natural sciences have opened up a broad avenue for the emergence and growth of new technology and made a great impact on all aspects of the economic and social life of our time.

Since the Third Plenum of the 11th CPC Central Committee, the CPC Central Committee and the State Council have attached great importance to the magnificent role played by science and technology in socialist modernization, called on the people across the nation to march toward modern science, advocated respect for knowledge and talent, and set forth a series of policies to promote China's scientific prosperity under the new historical conditions.

1. Pay Attention to Basic Research and Strengthen Applied Research

Historically, scientific development has deeply affected and changed the course of society. Especially today, not only have science and technology already deeply penetrated each and every aspect of economic and social life to become a major factor promoting economic and social progress but, as an intellectual system, they are exercising an increasingly important influence on the economic and social policy decisions of the state. Therefore, we must attach great importance to scientific research.

Modern science and technology are facing a great revolution. In the past 30 years, all fields have witnessed profound changes and continued to generate a series of new sciences and technologies. Facts have explained that major breakthroughs in theoretical research will inevitably bring about huge progress in production and technology. Consequently, economic development and technological innovation must have certain basic research to serve as their guide and reserve.

The law of nature that science needs to explore exists objectively. It cannot be changed by the subjective desire of the people or by changes in society. However, since different countries have different natural resources, conditions, cultural origins, historical traditions, social foundations, and forms of development, it is extremely important for a country to learn how to carry out, according to its characteristics and needs, the basic research of

natural sciences with distinctive national features to enrich its intellectual foundation for the natural sciences. Besides, some research tasks, such as China's geotectonic structure and the classification of plant and animal resources, can be accomplished only by Chinese scientists. They cannot and should not be accomplished by other people.

Much basic research is vital to the overall development of modern science. We must not ignore it. At the same time, a group of outstanding basic research scientists has emerged in China. They have carried out fruitful projects and made achievements that have become the focus of world attention. We should support and encourage them and create better conditions for them to make new contributions.

In order to train a large number of outstanding scientific research talents and raise the level of China's higher education, we urgently need to carry out high-quality basic research in natural sciences.

For these reasons, China's basic research has been resumed and developed since the smashing of the "gang of four." This is vital to promoting scientific prosperity. At the same time, in order to better coordinate the development of scientific research and economic and social development, we must vigorously strengthen applied research while stressing basic research. In sum, we should continue to attach importance to basic and applied research of crucial importance and ensure that they are carried out in a sustained and stable manner. It is impossible for the state to increase scientific research funds too much in the near future and production technology R&D urgently needs to be strengthened; therefore, investment in basic research can be increased only gradually from year to year on the basis of ensured stability. Stress should be placed on projects which require little investment, have immediate impact on the national economy or create the possibility of making creative achievements in the world. In 1986, the funds of the Chinese Foundation of Natural Sciences increased 100 percent compared with 1985. As for those large-scale scientific research projects which require greater investment, we can only do what we are capable of.

The severe challenge of the world's new technological revolution and the urgent needs of modernization at home have continued to set forth new demands on basic and applied research, forcing this research to continue to open up new fields and scale new heights, whereas basic research has laid a foundation for the advanced development of new technology, bringing about the renewal of technology while developing by leaps and bounds itself. In sum, new discoveries have negated the existence of old things and pushed people's knowledge one step forward while bringing up new questions in a new state of affairs. Weeding through the old to bring forth the new in science is an endless movement. For instance, the rapid development of biological engineering is inseparable from the theoretical research results of such disciplines as molecular biology, cytology, biochemistry, microbiology, and molecular genetics. Had it not been for the guidance provided by the theories of DNA structure and functions and the central dogma of gene expression and had it not been for the discovery of inscribed and continuous enzyme, the DNA recombination technique would not have been discovered. When carrying out

basic and applied research, we should pay attention to summing up and improving experiences theoretically. In the appraisal of basic research results, we should of course not emphasize their current economic results. We should mainly see their possible long-range social and economic significance and their scientific value.

2. Adhere to the "Double-hundred" Principle and Respect Academic Freedom

Scientific research is creative mental labor. In the fields of their academic research, scientists and technicians should have the freedom of independent thinking, the freedom to probe and debate, the freedom to express and hold on to their own views, and the freedom to make criticisms and counter-criticisms. Respect for these academic freedoms is a demonstration of respect for the salient features and law of the ideological production of human beings and the democratic rights of the people. Only by so doing can China's science become lively and prosperous and progress faster and better.

In 1965 our party set forth the principle of "letting a hundred flowers bloom and a hundred schools of thought contend" which is a Marxist principle to promote the prosperity of China's science and culture. However, due to various reasons, for a fairly long period of time, not only was this principle not implemented but, on the contrary, the so-called "academic criticisms," which ran counter to science and suppressed academic freedoms, prevailed in academic activities. Such "academic criticisms" were not normal discussions and debates of different opinions in academic circles. They were organized attacks on scientists and technicians with differing academic views carried out through the use of administrative powers. Since 1978, our party has summed up historical experiences and lessons, corrected past mistakes, and reestablished and resolutely implemented the principle of "letting a hundred flowers bloom and a hundred schools of thought contend."

With regard to academic rights and wrongs, we should not let any administrative leaders draw conclusions or let "the minority submit to the majority" and "the lower level submit to the higher level." We can find solutions only through free discussion and the test of practice (including scientific experiments). For many academic controversies, it is impossible to reach final conclusions within a short period of time. In the history of science cases in which relatively correct final conclusions were made only after several, dozens, or even a hundred years of contention, research, and exploration, can be found quite often. Because of this, we must have patience with regard to academic contention. In the academic sphere, people with differing views can form different schools. We should promote discussions among different schools, through which they can present facts, reason things out, air their own views, and speak their minds freely. Putting political labels on other people indiscriminately, misusing administrative powers to support one school and suppress another, and coercively promoting a certain academic point of view in academic contentions are erroneous practices and must be resolutely opposed. Only by so doing can we help bring into play the enthusiasm and initiative of the broad masses of scientific workers and encourage people to be fearless in seeking truth.

To really implement the "double-hundred" principle, we must correctly handle the relationship between philosophy and natural sciences.

The progress of natural sciences in modern history was a major basis for the evolution and development of Marxism. Similarly, the great progress of natural sciences in contemporary history is of a profound significance to the development of Marxist philosophy and social and economic theories.

The contemporary development of science and technology has not only changed man's material and economic life but also deeply affected people's consciousness and concepts. Between natural and social sciences, many new frontier and interdisciplinary sciences are continuing to appear. Therefore, we should pay close attention to the changes in social production and life style caused by the rapid development of contemporary science and technology and make penetrating probes into new issues that have arisen in the development of Marxism.

Marxist philosophy and a dialectic materialism world outlook are powerful weapons for guiding scientific research whereas the achievements of modern science and technology have also continuously enriched and developed Marxism. This is the basic relation that we must correctly understand and fully comprehend.

Science is developing and so is philosophy. We should never interpret the guiding function of Marxism as: Using existing philosophic conclusions and concepts as criteria for judging scientific rights and wrongs and denouncing everything which fails to meet the criteria as fallacies and anti-Marxist viewpoints. We should of course not consider our own or the "authorities'" intellectual limitations and prejudices as the limit of scientific exploration and think that anything beyond this limit is nonsense. At a time like today when natural and social sciences are permeated by and closely linked to each other, if careless, it is very easy to commit such mistakes. Then, we will repeat the past mistakes that criticized and negated the new creations of mankind and the new ideas which had not been widely recognized, or scientific phenomena awaiting further cognition by mankind for they were considered as heretical beliefs or even "capitalist sugar-coated bullets," resulting in irremediable losses.

To implement the "double-hundred" principle, we must also correctly handle the failures of scientific exploration.

The task of science is to seek truth whereas truth-seeking cannot be accomplished at one time. No matter how talented or well educated a scientist is, he will necessarily commit mistakes of one kind or another in the course of exploration and sometimes confront imperfection or failure in scientific experiments. It is unavoidable for numerous scientific workers to be different in their ability to understand and use Marxist theories. We must not be overcritical in this regard. If failure is not permitted in exploration, there will be no way to carry out exploration, thereby blocking the road to success and creativity. Besides, whether or not something is really "wrong" needs to be proved through practice. Many correct and

scientific ideas and viewpoints were taken for "mistakes" and criticized when they were first introduced; whereas erroneous ideas were taken for correct stuff and worshipped for a long period of time due to the restrictions of historical conditions. Therefore, in the academic sphere, not only should we avoid judging certain views currently under contention as "correct" or "erroneous" but we should also make historical analyses of things although they have actually been proved erroneous by practice. We should offer sincere help to actual working personnel instead of sending large numbers of people to suppress them. Only by so doing can we open up broad avenues for ideas, opinions, and talented people and be fearless in seeking truth.

The discussions of major economic or scientific and technological policy decisions, state and regional development strategies, relevant policies, and measures and the technical appraisals and feasibility analyses of major engineering projects are of course different from the contentions of academic thoughts because for such discussions and appraisals, judgments and conclusions must be made promptly in order to facilitate implementation. Nevertheless, leaders should fully heed the opinions of scientists and technicians and promote the liberation of thinking, seeking truth from facts, speaking one's mind freely, and carrying out contentions. Before a decision is made, if scientists and technicians have differing views, they should be encouraged to bring them up. It is absolutely forbidden to interpret differing views as "not in consensus with the party." After a decision is made, everybody should of course comply with and carry out the decision. However, scientists and technicians may still reserve their own academic viewpoints and differing opinions.

Safeguarding academic freedom is the responsibility of both leaders and scientists. Famous and authoritative scholars should pay more attention to safeguarding the academic freedom of the younger generation and of those who are fighting in obscurity in the same field. They should be careful not to suppress different opinions and the academic criticisms of "nobodies." On the other hand, the younger generation should also take note of respecting the views and different opinions of scientists of the older generation.

3. The Special Law of Basic and Applied Research Must Be Respected

Compared with technological development, basic research and basic applied research have a very different nature, that is, they require a high degree of flexibility which increases the demand for the autonomy and freedom of scientists and technicians. Therefore, with regard to basic research and basic applied research, generally we only need to formulate guidelines and specify what areas need to be developed first. From now on, this kind of research project generally should be given directional guidance through the planning guide of the State Natural Sciences Foundation. At the same time, in order to coordinate the development of all disciplines, we should also encourage the grassroots units of scientific research to arrange on their own proper projects for basic research and basic applied research.

Most of state-arranged research projects that fall into the category of basic research and basic applied research during the "Sixth Five-Year Plan" have a

clear prospect in application, and are intended to consolidate scientific reserve for the development of economic construction and increase the ability of technological development. These major projects can be roughly divided into three categories: 1) Major scientific and technological issues, that either have a direct bearing on major state construction projects or that urgently need to be solved in economic development, such as basic research and low-quality energy resource utilization concerning off-shore oil exploitation; 2) projects proposed from the angle of scientific and technological development which also have a very important future in application, such as biological engineering, surface and interfacial physics, cryophysics, catalytic theory and new catalyst; and 3) projects which currently have no foreseeable future in application but are of great scientific significance and impact on society such as high-energy physics and astrophysics.

As for those technological development projects which give direct solutions to problems in industrial and agricultural production and those applied research projects closely linked to the former, arrangements should be made according to command plans, but they should also be distinguished from production plans in regard to work progress and the achievement of possible technical and economic targets. They must maintain the necessary flexibility and elasticity.

In basic research and basic applied research, special attention should also be paid to maintaining the stability and continuity of research work. Projects should not be suspended easily.

The cycle of basic research and basic applied research is generally fairly long. It often takes many years of efforts before one can expect to achieve success in a crucial research. It is not easy to achieve major results without the guarantee of a stable policy. Many current major scientific and technological results, which have yielded good economic and social results in production, were achieved as a result of protracted unremitting work in basic research which began several years or even 10 or 20 years ago and then was transferred to applied research and practical technology development. We should take note of maintaining the stability and continuity of basic research and basic applied research, adopt a broad, long-term view, have some foresight, and avoid starting or cancelling a project rashly and abruptly or casually deciding to stop a research project which is being carried out.

4. Strengthen Close Ties Between Scientific Research and Higher Education

Institutions of higher education and the Chinese Academy of Sciences have a great variety of disciplines, a concentrated force of high-level experts, a large number of teachers, scientists, technicians, and undergraduates, a good academic atmosphere and an environment of information exchange. This contingent of multi-disciplinary and multi-level personnel is capable of opening up new and inter-disciplinary fields and carrying out comprehensive research on major scientific issues. They have a greater scientific potential and creative spirit. They should be able to take on major tasks in basic research and basic applied research in accordance with the state's in-depth

disposition for scientific research and the needs of training high-level specialists. At the same time, they are also capable of transferring as soon as possible the results of applied research to technological development or to technologies with direct economic results. The Chinese Academy of Sciences and institutions of higher learning also have some strong technological development forces. We should give full play to their role and do a really good job in technological development.

The research institutes of industrial sectors, where technicians and engineers are relatively concentrated and scientific and technological work is closely linked to production tasks, shoulder part of the tasks of applied research and massive development. These research institutes should focus on solving a host of problems concerning the crucial technologies of production development and the transfer of technology to productive forces. At the same time, they should also conduct leading research and strengthen applied research according to demands. Those which have conditions should properly carry out basic research to ensure a lasting support to scientific and technological development.

The state encourages different research institutes to carry out comradely emulation in regard to the standards of research work and contributions to state construction. At the same time, the state also vigorously promotes cooperation between different research institutes, experts, and scholars in conducting research and training talented people, encourages and promotes the close combination of scientific research, teaching, and production, supports multi-disciplinary, inter-departmental integrated research tasks, accelerates the extensive exchange of academic thoughts, and vigorously facilitates the flow of scientific and technological information to all fields.

To accelerate the development of China's scientific undertakings, we need large numbers of outstanding scientists and technicians in addition to correct policies and principles. Only by training thousands of brilliant people can we give impetus to improving the scientific and cultural levels of the Chinese nation as a whole. The future of science lies in youth. We should pay more attention to training and educating youngsters. Only the healthy growth of the new generation can provide a guarantee for the prosperity and succession of our undertakings.

Since the founding of our country 36 years ago, we have formed a scientific and technological contingent that has a great variety of disciplines, the ability to solve many scientific and technological problems in China's economic and national defense construction, and that has fairly high standards. However, compared to the demands of the four modernizations, we have a serious shortage of competent scientists and technicians and still suffer from the irrationality of the personnel structure.

During the 10 years of turmoil, China's educational order was totally disrupted. The institutions of higher education stopped student enrollment for 4 years. According to the scale of enrollment at that time, approximately 650,000 would-be college students were turned away during the 4-year period.

The enrollment was not resumed until 1970. According to a rough estimate in 1982, among the 4.471 million college students graduated after liberation, about one-fourth were affected to varying degrees by the "Great Cultural Revolution," thus lowering the quality of education. Moreover, because the proportion of vocational and technical schools is too small and because of other reasons such as "leftist" influence in the personnel system, the age structure of the scientific and technological contingent has become irrational--small at both ends and big in the middle. According to a human resource forecast, if we fail to adopt measures now, the temporary shortage problem of academic leaders will become increasingly worse.

The training of high-level scientific and technological personnel should be done mainly through on-the-job training. In addition, it can also be done through the development of candidates for master's and doctor's degrees and post-doctorate researchers. According to statistics for China's graduate students, 82.2 percent of them are trained in institutions of higher education, 8.2 percent in the Chinese Academy of Sciences, 7.5 percent in different departments of the State Council, 1.1 percent in the Chinese Academy of Social Sciences, and 1 percent in local scientific and technological institutes.

Combining basic and applied research closely with the training of competent people is an effective way to train high-level scientific and technological personnel. It is conducive not only to teachers in raising teaching standards but also to scientific researchers in broadening knowledge in basic theories. It is also conducive to the discovery and training of outstanding new rising forces. Only high-standard basic and applied research can being up high-standard teachers' contingent and train high-standard personnel. On the same token, only when we do a good job in education can many competent people emerge and can basic and applied research gain the steady support of intellectual resources and continue to develop. China's reform has created an increasingly better environment for the emergence of top-notch people. Along with the deepening of reform and the development of scientific research and educational undertakings, it is certain that we will welcome an excellent situation in which talented people keep coming forth in great numbers and numerous stars glitter.

5. Vigorously Develop International Cooperation and Academic Exchange

China's existing scientific achievements are very incompatible with a socialist country like ours. We cannot change backwardness unless we admit it first. We must learn from the advanced; otherwise, it will be impossible for us to catch up with them.

To raise China's scientific level, first, we must rely on our own efforts and develop our own creativity. However, we must not close our country to international intercourse and be complacent and conservative. We should encourage Chinese scientific workers to strive to study and master the new achievements of modern science in the world. There is no class or national boundaries in natural sciences. We should not make various forbidden zones in scientific research to hinder and stop efforts to learn from the new scientific achievements and absorb the world's new scientific thoughts.

We should vigorously carry out international academic exchange activities, strengthen friendly ties and cooperative relations with the scientific circles of all countries, and vigorously absorb and assimilate advanced foreign scientific research results and technologies that are applicable to China.

Of course, in order for our scientific research to gain a foothold in the world and do a good job in international exchange, we must do a good job in research projects that have rich Chinese characteristics in accordance with China's salient features, natural resources, foundation and needs. The more results we achieve and the higher our academic level is, the better we will be in international relations. In many research tasks such as the harnessing of the Chang Jiang, the investigation of the Himalayas, the cause of the rise of the Qinghai-Xizang Plateau, the study of China's geotectonic structure, and the theory of the oil formation of intracraton basins, our work cannot be done by other people. We cannot solve our problems unless we rely on the hard work and conscientious study of Chinese scientists. We also have the responsibility of enriching the world's science treasure-house with our achievements. The outstanding accomplishments of Chinese scientists in number theory, computational mathematics, molecular biology, science of geology, theoretical physics, and the probe of the mysteries of life have proved that the people of China are intelligent and totally capable of making major contributions to the scientific development of the world.

With the power of science and technology, mankind has substantially developed the productive forces of society and raised labor productivity to an unprecedented level. Consequently, emphasizing and supporting science obviously is an important sign of social and cultural progress. Since the Third Plenum of the 11th CPC Central Committee, our country has witnessed profound changes, and our party and government have formulated a series of policies and principles for promoting scientific prosperity. As long as we implement them conscientiously, China's scientific undertakings are bound to rise like the sun in the eastern sky, thrive and prosper. It is certain that China's scientific prosperity will reach a new plane.

12302/6091
CSO: 4008/7

CHAPTER 2. TECHNOLOGY POLICIES

[Text] This year, the State Council has promulgated the main points of technology policies on energy, communications and transportation, telecommunications, agriculture, consumer goods industry, machine-tool industry, materials industry, construction materials industry, urban construction, rural construction, urban and rural housing construction, and environmental protection, a total of 12 fields.

Policies are the criteria of human activities. China has always stressed the traditions of policies. In the past, however, they were mostly political, military, and economic policies. In a new historical period when the national work is focused on modernization, the study, formulation, and implementation of technology policies in some important fields constitute an important step in the implementation of the strategic principle that "economic construction must rely on science and technology, and science and technology must be oriented to economic construction," and will play a tremendous role in China's technological progress and economic prosperity.

I.

Along with rapid scientific and technological advances and economic and social developments, more and more plans and ways to attain a certain goal are now open to choice, and the factors to be considered by the governments and departments at all levels are becoming more and more complex. In order for the technological and economic developments to continue according to objective laws, we must have clear-cut technology policies.

Contemporary science and technology have infiltrated economic and social activities as well as people's thinking. One thing we must do to make better use of science and technology is to popularize the new technologies, new techniques, new materials, new equipment and new products, and people are already aware of the importance of this requirement. Another very important requirement is that we must make use of modern scientific and technological knowledge and means in supplying scientific data for macroeconomic management and policy decisions in economic and social development so that correct policies can be formulated. The latter requirement is now increasingly obvious for economic and social developments as well as for the self-advancement of science and technology.

In the past, what we lacked was sufficient attention to policy research. In the absence of technology policies, and because of our wrong policies, our work in science and technology and in economic construction inevitably took wrong paths and brought serious losses.

In the past several years, China has reviewed and drawn lessons from its experiences, and began to attach greater importance to the work of technical policy research and formulation. Since 1979, research has begun in technology policies on energy, communications, machine-tools and other fields. According to the State Council's planning, since January 1983, the State Science and Technology Commission, the State Planning Commission, and the State Economic Commission, in collaboration with other relevant departments, have organized the work of formulating technology policies on a national scale.

Technology policies were also formulated in other important fields. This is an important task of the new historical period as well as a pioneering undertaking. To ensure that policies are scientific and rational, a program of extensive democracy including the stages of soft scientific research, drafting and confirmation of the documents, comments from various localities and departments, and revisions of drafts, were carried out. Several thousand comrades, including scientific and technological experts, economic experts, and administrative cadres, took part in the study and formulation of technology policies in 12 fields. With the overall national interests as their primary concern and in light of the national conditions, these comrades firmly adhered to the principle of seeking truth from facts and combining technology closely with economy, and pooled their resources under the principle of "letting a hundred schools of thought contend." They carefully studied the historical and the present conditions and the trend of technological and economic development at home and abroad, drew lessons from their past experiences, and conducted systematic qualitative research and quantitative analyses on the important questions which had been topics of long debates. After comparing many different plans, they finally reached a unanimous conclusion.

The work of these comrades has not only culminated in the formulation of many technology policies at the national level, but also promoted similar research in various departmental and local levels. Many departments have now formulated and implemented their own technology policies, while some localities are doing the same for local development.

II.

Technology policies are the criteria to which technological and economic development must conform in order that technological progress may promote economic development.

Because of the close relationships between research and exploitation on the one hand and production and construction on the other, and between technology and economy, technology policies inevitably play a "dual" role. Little success can be achieved if we only conduct research and exploitation simply for the sake of technological development regardless of production and

economic development, or strive for only economic development regardless of technological progress. Therefore, the technology policies should consider the technological, economic and social factors as a triad which includes research and exploitation as well as production and construction, and should be the development policies which both technological undertaking and economic construction should follow.

Of course, there are relationships as well as differentiations between technology policies and production and economic policies. Production policies transcend trade barriers and are mainly concerned with the economic layout, the production structure, and the proportionate relationships between various industries. Economic policies are mainly concerned with pricing, finance, banking and trading. The issues of purely economic policies and production policies are not addressed by technology policies.

There are generally four aspects of technology policies:

1. Development Goals

Appropriate development goals must be set by the technology policies. The goals of technological development must be consistent with the goals of economic development. They must also include an objective analysis of the trend of technological developments in the world, and proceed from the realities of China's technological capabilities and economic and social conditions.

2. Industrial Structure

The industrial structure includes an industry's technological structure, production setup, and product mix. Based on an analysis of the industry's present productive forces, technological standards, and development capability as well as the social demand for its products, we must determine the relationships between productive forces and modes of production, rational ratios, scope and layout, speed and sequence of development, technological structure, orientation of major products, and principles of consumption and distribution in the industry.

3. Choice of Technology

The criterion for the choice of orientation of technological development, that is, the basis of decision on the adoption, development, restriction or elimination of any technology, is the amount of comprehensive economic and social benefits to be derived. Although the progressiveness of technology is certainly an important factor to be considered, we must nevertheless proceed from China's technological capability and its natural, economic and social conditions and conduct an overall evaluation of the progressiveness and economic and social values of the technology in making our choice, with the promotion of the whole country's technological development as a prerequisite.

4. Channels, Lines, and Measures To Promote Technological Progress

The scope of this requirement is very sweeping. It includes, for example, strengthening research and exploitation, promoting the industrialization, utilization and commercialization of technological achievements; importing, assimilating and absorbing suitable advanced technologies; adopting new technologies to accelerate the transformation of the traditional industries; following a rational procedure and optimal plan in overall planning, comprehensive exploitation and supportive construction; perfecting the system and structure of quality assurance; adhering to the principle of standardization, serialization and interchangeability; achieving the modernization of management with advanced technical ways and means; promoting specialized and socialized production and cooperation; improving and strengthening the infrastructure to support technological and production developments; raising the quality level of equipment; using resources and energy properly and effectively; protecting the ecological environment; correctly selecting the important technological line and process, and so forth.

In working out the technology policies for a certain field, we should note its special characteristics and existing problems, grasp the principal contradictions that have an impact on the overall situation, and adopt the necessary measures.

III.

Technological policies provide the program for scientific and technological as well as economic and social development. They also serve as an important basis for the solution of difficult scientific and technological problems, for technical transformation and technology importation, for key construction projects and the readjustment and development of the production structure. They are an important guarantee for the smooth progress of the modernization drive. Like political and economic policies, the technology policies fully deserve high regard and should be conscientiously implemented.

The 12 technology policies now promulgated are based on the general situation of the whole country. Because of the great differences among the localities with regard to their natural, economic, social, and technical conditions, we must carefully note the actual local conditions in the course of the implementation and provide prompt information feedback.

This is the first time that technology policies have been formulated and implemented on such a large scale in China, and many problems have to be further studied. Furthermore, in view of the rapid advance of contemporary science and technology, the rapid economic and social developments, and the accelerated updating of technology, any type of policy has its temporal and spatial constraints. Therefore, we must carefully note the new trends of technological and economical developments, continue our in-depth policy research, and make timely readjustments and revisions of our technology policies.

Under the new conditions of the reform, the state organs at various levels should be good at the use of policy guidance in order to further improve their work performance. To help the scientific and technological personnel, the economic workers, and the administrative cadres understand and implement these technology policies, excerpts of the 12 technological policies promulgated by the State Council on 24 May 1986, are published as follows:

Section One

Main Points in Energy Technology Policies (Excerpts)

I. Increase the Production of Primary Energy, Improve Its Structure

--The key to the solution of the energy problem lies in the effort to increase the production of primary energy. There must be good coordination in the speed, scope, layout and sequence of development between the national economy and primary energy, between various types of primary energy, between primary and secondary energy, especially electric power, between energy production, transmission, and consumption, and between energy and environmental protection.

--Coal is China's main energy source. We must quickly expand the scope of coal mines now under construction, shorten construction time, and upgrade equipment.

--For petroleum, the main task is to increase reserves. We must speed up the general survey, the prospecting and the exploitation of petroleum resources and strive for increased output.

--Exploitation of water power is the most practical way to improve the structure of primary energy. China has good potential in the exploitation of water power resources, and it must have the determination to develop hydroelectric power.

--Active efforts should be made to develop nuclear energy. Nuclear power plants of a suitable size should be built in economically developed but energy deficient areas.

--Natural gas is an important latent energy resource in China. We must step up the general survey, prospecting and exploitation of natural gas and strive to increase its role of a primary energy source.

--Great efforts should be made to develop forest energy, oil shale, and other new energy resources.

II. Form Energy Economic Zones and Composite Energy Zones, Readjust the Distribution of Productive Forces

The distribution of China's productive forces does not correspond with its distribution of energy resources. Based on the energy resources in various localities, the relationship between energy production and consumption, and

rational energy flow, we should set up rational energy economic zones across departmental and regional barriers.

--Concentrated efforts should be made in planning and setting up a certain number of composite energy zones and adapting our measures to local conditions in exploiting the resources.

--The distribution of productive forces and the relationship between energy production and consumption should be readjusted, and some optimal plans should be drawn up for interregional energy transmission. New enterprises which are heavy energy consumers should be located as close as possible to the place of energy production.

III. Accelerate Coal Exploitation

--The prospecting and exploitation of coal resources should be carried out under a unified plan, and only the good resources should be exploited. While stepping up the exploitation and enlarging the construction scale of new mines in the eastern regions, we should also strengthen the prospecting and exploitation of coal resources in the western regions. In coal mine construction, we should uphold the principle of a combination of large, small and medium-size mines.

--We should use highly efficient drilling technology, advanced digital geophysical exploration equipment, data processing systems, remote sensing technology, and mathematical geology to accelerate the comprehensive prospecting of coal fields.

--Large opencut mines should be built in Shanxi, Nei Monggol, and Shaanxi.

--To shorten the period of mine construction, we should improve mine design, do the advance work well, adopt advanced technologies and highly efficient supportive equipment, develop fully mechanized equipment in the mining lanes, step up the organization and management of mining, and synchronize auxiliary projects with mining operations.

--For existing mines, we should carry out technical transformation and centralized production properly, reform mining techniques, upgrade equipment, and increase the overall productive capacity and the rate of resource recovery.

--Large mines should develop full mechanization in coal extraction and tunneling, and mechanization for auxiliary projects.

--All coal mines must strictly enforce safety regulations and adopt advanced technologies for all-round prevention of underground disasters.

--Local state-owned coal mines and small collective coal mines should be actively developed. We must strengthen their scientific management and provide the necessary technical guidance and support. Some local coal mines should be selected for technical transformation, while suitable technologies

should be studied and popularized among the small mines. The resources should be rationally distributed, and the indiscriminate opening of small coal mines in the areas where coal fields have been, or are soon to be constructed must be prohibited.

IV. Attach Primary Importance to General Surveys in Petroleum Industry, Improve Economic Results in Exploiting Oil Fields

--We must step up comprehensive survey, and use advanced comprehensive technologies for prospecting as much as possible.

--We must develop the technology of optimal drilling and directional drilling, use fine-quality drilling mud, and raise the speed and quality standards of drilling.

--We must develop and improve the technology for secondary extraction of oil while studying the technology of tertiary extraction. Provided the rate of oil extraction can be raised, we should suitably increase the speed of extraction, and study the technologies of extracting oil reserves which have infiltrated into the deeper layers, as well as thickened oil reserves.

--We should fully recover associated gas and condensate, and improve the technologies of bulk transportation and the processing of oil and gas.

--We must quickly master the technologies of prospecting and exploiting offshore oil and gas resources.

--We must develop the technology of closed transportation of oil, study the technologies of high-pressure pipeline transmission of oil with high wax content, and lower the energy consumption and transit losses.

--We must step up prospecting for oil shale resources, support and develop its production, and study techniques to improve its processing and comprehensive utilization.

V. We Should Prioritize the Exploitation of Hydroelectric Power as a Renewable Primary Energy Source

--In hydroelectric power construction projects, we must strengthen preliminary work and overall planning, and carry out the continuous exploitation of cascades. We should also construct power stations for the regulation of reservoirs, run-off power stations, or pumped-storage stations according to local conditions.

--There must be comprehensive utilization of water resources, and water power exploitation must be considered in light of navigation, irrigation, water supply, flood prevention, and drainage, aquiculture, tourism, and the ecological environment. The benefits and the required investment should be reasonably shared by the parties concerned.

--The scope of hydroelectric power construction should be expanded as much as possible. In hydroelectric power projects, large stations should serve as the backbone, and some large projects with outstanding economic results should be selected and started as soon as possible. Medium-sized hydroelectric power stations should be included in the overall plan, and the localities and enterprises should be encouraged to raise their own funds for their construction with state support. Whoever builds the station will benefit from it. The energy-deficient areas of the east should have priority in the construction of medium-sized hydroelectric power stations.

--Small hydroelectric power stations have the advantage of full utilization of scattered water resources, and can play an important role in rural electrification. They should be actively developed under the policy of private construction, private management, and private use.

--Active efforts should be made to develop the technologies of building high earth and rock dams and light concrete dams, underground engineering projects of longer spans, long tunnels, and dams with foundations in deep strata.

--Construction machinery should be in complete sets. We must organize a specialized work force and set up specialized work bases to accelerate the progress of projects.

--We should trial-manufacture large turbogenerating sets, high water head generating sets of the impulse and the mixed flow types, pumped-storage generating sets, low water-head generating sets of the continuous-flow type, and other large equipment for the water power industry.

VI. Building Nuclear Power Plants in Economically Developed but Energy-Deficient Regions

--Pressurized-water reactors should be developed for the first generation of nuclear power plants.

--While making full use of the existing technological foundation, we should import advanced foreign technologies, turn them into Chinese technologies as soon as possible, and thus form a nuclear power industrial system.

--The general survey, prospecting and exploitation of uranium must be accelerated along with research in the technologies for the reprocessing of fuel and the disposal of the "three wastes."

--Relevant statutes, standards, and procedures of examination and approval concerning nuclear energy should be worked out.

--The work of nuclear energy heating and feasibility studies and experiments on nuclear thermal power plants should be actively carried out.

--Research on new types of reactors should be strengthened.

VII. Equal Importance for Natural Gas and Petroleum Exploitation

--The general survey and prospecting of natural gas, and particularly coal gas, should be stepped up.

--We should develop the technologies of prospecting, exploiting, processing, transporting and storing natural gas, especially the technology of seismic prospecting for natural gas in the shallow and the deeper strata, and the technologies of geophysical well logging and gas testing. The technology of underground gas storage should also be studied.

--To exploit natural gas fields, we must have sound overall planning and the auxiliary facilities to ensure balanced production and utilization.

VIII. Accelerate the Development of Electric Power

--Electric power should take the lead. Large electric power stations should serve as the backbone of electric power projects, while small and medium-sized stations should be built according to local conditions. The proportion of hydroelectric power should be higher, nuclear power should be developed, and active efforts should be made in the utilization of new energy.

--New large thermopower plants should be built as close to the mining sites as possible. The large thermal power plant built in the load centers should be economically rational and able to meet the requirements of environmental protection. Thermal power plants should be built in large and medium-sized cities and industrial centers requiring central heating.

--We should trial-manufacture advanced equipment for large thermal power plants. The power stations located in coal-rich but water-deficient areas should actively adopt the technologies of air-cooling and dry dust removal. The utilization of ash should be developed.

--The regional power grids should be strengthened and gradually expanded to merge with one another. The large power grids should carry out optimal plans and set up a unified allocation system. Advanced technologies should be adopted for optimal allocation. We should master the technology of transmitting 50 kV ac power, explore the technology of transmitting ±500 kW dc power, and study the technology of transmitting ac power of an even higher voltage.

IX. Active Exploitation and Utilization of New Energy

--We should exploit and utilize solar energy, biomass, wind energy, geothermal energy, tidal energy, ocean energy and other new energy resources to supplement conventional forms of energy. We should also strengthen the work of scientific research and demonstration, actively popularize achievements in scientific research, and gradually form a new energy industry.

--In the southern regions, we should develop methane tanks for household use. We should also improve the techniques and equipment of fermentation, develop

the technologies of central heating and small-scale methane power generation, and conduct research in new techniques of gasification of agricultural and forest residues.

--In regions which are seriously deficient in energy and enjoy good sunlight, we should actively develop and utilize solar energy, trial-manufacture and popularize solar cookers, solar heaters, solar-energy battery cells, and solar dryers.

--In regions with abundant wind energy resources, small windmills should be developed.

--The survey and appraisal of geothermal resources should be strengthened. Geothermal power of low temperature can be used directly. For the utilization of high and medium-temperature geothermal power, geothermal power plants should be built.

X. Raise Energy Utilization Rate, Practice Energy Conservation

--We must decide on plans for the rational processing, effective use, and optimal distribution of energy, and practice comprehensive utilization.

--Great efforts should be made in studying energy conservation, and in the development and popularization of new technologies, new techniques, new equipment and new materials for this purpose.

--Technical transformation for energy must be accelerated, and a time limit must be set for the elimination of the equipment of low-efficiency and high energy consumption. Industrial boilers, water pumps, ventilation equipment, powered machines, diesel engines and the other bulky mechanical and electrical products must be updated. Industrial kilns should be transformed, and low and medium-pressure power generating sets should be gradually renovated or transformed. We should set up a system of permits for the manufacture and use of high energy consumption equipment, organize specialized production, restrict the modes of production (particularly indigenous coking) and transportation that may bring serious energy losses, improve urban roads and highways, and reduce gasoline consumption of motor vehicles.

--The product mix of high energy consumption industries should be adjusted. We should lower the iron-steel ratio, vigorously develop phosphate fertilizer and potash fertilizer, popularize the use of heat insulation materials and energy-saving wall materials.

--We should develop energy conservation technologies for coal mines, oil fields, gas fields and coal oil projects and power plants, and reduce the proportion of energy consumed in the energy industry itself.

--Energy-saving houses should be designed and popularized. We should improve the insulating property of buildings, fully utilize natural energy, and raise the energy-utilization rate of equipment.

--We should conserve energy in commerce, improve foodstuff refrigeration, and adopt new cold storage technologies to save energy.

--The recovery and reuse of energy should be actively promoted, and the residual heat and diffused combustible air in industry should be properly utilized.

--We should speed up the trial manufacture, production, and installation of energy meters and other means of energy measurement.

--Scientific management of energy should be strengthened. We should work out the statutes for energy conservation, strengthen the management system, form a unified index system of energy conservation, conduct a general survey on energy utilization and a test on energy equilibrium, carry out forecast and planning on energy conservation, introduce a system of energy consumption quotas and a system of verification; and improve energy standards.

XI. Rational Use of Petroleum and Natural Gas, Improvement of Oil Processing and Oil Product Distribution

--In the production of petroleum products, greater attention should be paid to fuel used in portable internal combustion engines and the raw materials and lubricants for the chemical industry, and these products should be distributed properly. Except for special reasons, direct burning of crude oil is forbidden. Oil burning should be gradually reduced.

--The variety, specifications and standards of oil products should be determined as required, and their quality should be improved.

--Heavy fuel oil suitable for large diesel engines of high efficiency and medium and low speed should be developed.

--We must develop the technologies for catalytic cracking, hydrogenization of heavy oil and residual oil, processing solvents, and other types of intensive processing. We must also raise the proportion of light oil production, and increase the output of diesel oil, raw materials for the petrochemical industry, and asphalt and acicular coke for the road.

--We should comprehensively utilize natural gas, the associated gas of oil fields, and the gas of refineries. We should also develop the technology of producing low-cost hydrogen and high-octane gas.

--We should trial manufacture new highly efficient and multifunctional catalytic promoters, and improve the technology to produce better additives.

--Oil refining and processing enterprises should be large in size, and indigenous refineries must be eliminated. Small refineries and small petrochemical plants should be closed, suspended, merged or retooled within certain time limits, unless they are engaged in the production of special products for scientific experiments and producing good economic results.

--Based on a comprehensive optimization of the extraction, transportation, refining and marketing of petroleum, we should determine the geographical distribution of refineries and the volume of their processing work.

XII. Improve the Technologies of Processing, Burning, and Transforming Coal and Distributing Products, Practice Comprehensive Utilization

--We should develop the methods of screening and washing coal for selection, improve the quality of commodity coal, and increase its variety. We should also adopt advanced technologies for selecting coal, examining its quality, and distributing them with power machinery. State-controlled coal mines should gradually introduce a system for supplying commodity coal according to the conditions of resources and the major consumers' requirements at designated spots, in fixed quantities and of designated quality. A system of measuring the quantity of commodity coal after screening and washing will also be gradually introduced.

--Different standards of quality and different quotas will be set for different categories of consumers.

--Attention should be paid to the comprehensive optimization of coal production, transportation and marketing.

--Great effort should be made to study the special characteristics of coal and combustion technology. The heat efficiency of combustion equipment, especially industrial boilers, kilns, and household coal stoves should be raised. The new technologies of fluidized-bed combustion and burning coal slurry should be studied.

--Low-heat fuel of less than 3,500 kcal/kg, such as lignite, intermediate dressed coal, peat, gangue, bone coal, and oil shale, should be comprehensively used locally.

--In accordance with the principle of specialization for cooperation and sound economic logic, and in the mining areas where conditions are favorable, we should establish integrated enterprises dealing in coal, electric power, gas, chemicals, coke, and construction materials for the comprehensive utilization of coal resources.

--We should actively develop coal gasification and coal chemicals industries, and concentrate our efforts on processing tar and increasing the variety of products. We should also step up our research in the technologies of producing synthetic raw material gas, urban gas, and industrial fuel gas from coal (including the new technology of producing gas in combination with methyl alcohol); and the new techniques of producing engine fuel from liquefied coal.

XIII. Set Up a Rational Rural Energy Structure, Quickly End the Serious Rural Energy Shortage

--To develop rural energy, we should uphold the principle of adapting measures to local conditions, using different energy resources to supplement

each other, achieving comprehensive utilization, and stressing economic results.

--Commodity energy should be used mainly in rural production. We should gradually increase the supply of commodity energy to the countryside and actively develop small hydroelectric power stations and small coal mines. In areas that have abundant coal resources but an insufficient power supply or no power supply whatsoever, a suitable number of small thermal power plants may be developed to promote electrification and to make the power supply more dependable.

--Biomass should be used mainly in rural life. Efforts should be made to increase firewood resources and to popularize the use of fuel-saving stoves which can maintain a heat efficiency of more than 25 percent. Methane tanks with a commodity rate of above 20 percent should be developed for household use along with the establishment of small and medium-sized methane supply stations. We should also study the technology of biomass conversion.

--Forest energy should be developed. We should change the traditional and inefficient way of operation and carefully select and plant more fast-growing trees that have high heat value.

--We should develop energy-saving farm machinery and highly efficient machines for both people and draft animals.

--We should study and popularize the technologies of energy conservation in the countryside.

XIV. Improve the Pattern of Urban Energy Consumption To Meet Legitimate Demands in Daily Life

--Every effort should be made to supply urban residents with clean, good quality energy.

--Urban power supply should be increased, and household electrical appliances with low energy consumption should be developed. If conditions permit, electricity can be suitably increased for cooking.

--Gas from different sources should be properly used and fuel gas for the cities should be developed. Cities with favorable conditions should actively develop coal gas and make full use of coke-oven gas and mine gas. Natural gas and liquefied petroleum gas, unless used as raw materials in the petrochemical industry, should be supplied first to civilians.

--Great effort should be made to improve the technology of using household coal. We should actively trial manufacture new types of highly efficient, multipurpose household stoves that may create less air pollution, develop honeycomb [charcoal] stoves and similar products, and strictly forbid the burning of loose coal.

--Central heating should be developed in the cities, and a rational plan for this purpose should be worked out on the basis of heat load conditions and the overall plan.

XV. Raise the Quality and Technical Standards of Energy Equipment

--We must make every effort to develop advanced energy equipment. The manufacture of energy equipment should be coordinated with the development of the energy industry with regard to speed, scale, and time sequence, in such a way that the former should precede the latter by an appropriate margin.

--We must uphold the principle of "quality first," and gradually adopt international standards.

--On the basis of self-reliance, we must act in accordance with the principle of combining trial manufacture at home with important technology from abroad so that in scientific research, design, manufacture, service, and renovation, a system of energy equipment uniquely Chinese can be gradually formed.

XVI. Prevention of Environmental Pollution From Production and Use of Energy

--Environmental factors must be considered in developing, converting, transporting, and using energy. Proceeding from the benefits to the society as a whole, we must analyze the advantages and disadvantages and decide on a plan of action that will be most advantageous to the environment. Related measures will be included in the economic and social development plans.

--We should create an energy-environment model and formulate a comprehensive regional energy-environment plan.

--Statutes should be formulated to prevent pollution from energy.

--The key to prevention of pollution from energy is improved technologies for distributing and using coal.

Section Two

Main Points of Technology Policies on Communications and Transportation (Excerpts)

I. Increase Transport Capacity, Gradually Readjust the Transport Structure, Take Advantage of the Merits of All Modes of Transportation, Set Up a Modern, Comprehensive Transportation System That Is Economically Rational and Well Coordinated

--Efforts must be made to increase the transport capacity, to bring about the cooperation and coordination of various modes of transportation in development, to form a comprehensive transportation network and to vigorously develop a joint transportation system that includes all modes of transportation.

--Railways will remain China's mainstay in long-distance passenger-freight transportation in the foreseeable future. We must accelerate the technical transformation of railways, especially the trunk lines mainly engaged in coal transportation, and the construction of new railways. In the near future, we should pay particular attention to the upgrading and expansion of existing lines.

In order to take better advantage of railways to move bulk cargo and petroleum products in larger quantities, we should use other modes of transportation as much as possible for short hauls of less than 100 km, for broken shipments, materials suitable for marine transport, passenger traffic between ordinary cities and towns that are within 200 or 300 km along railways, and for passenger traffic between large and medium-sized cities that are farther apart.

The development of special railways must be controlled.

--Highway transport must be given full play as the principal means of short-distance passenger and cargo hauls. Along with the improvement of highway conditions and the advance of motor vehicle technology, highways will gradually become an important means of transportation for high-grade products and passengers over medium distances. We must accelerate the technical transformation and building of highways, especially trunk highways.

--Coastal sea and inland river transport will be one of the principal modes of moving bulk cargo. We must open more inland waterways so that the loads may reach their destinations through joint river-sea transport without interruption. We must also expedite the transformation and construction of ports along the coast and inland rivers, and actively develop passenger and cargo transportation along the coast and principal inland rivers, such as the Chang Jiang.

The role of water transport must be brought into full play. Apart from short railway feeder lines, we will, as a general rule, build no more railways parallel to inland rivers.

--Air transport has obvious superiority for long-distance passenger transportation and must be actively supported. Priority should be given to widespread large and medium-sized cities in air transport development. We should also develop air transport to and from frontier and remote areas and for transporting high-grade products, goods for foreign trade, and other urgently-needed materials.

--In addition to crude oil and natural gas, pipeline transmission of finished oil products should be developed as quickly as possible, and more coal slurry pipelines should be developed. The technology of pipeline transmission of petroleum-associated gas should also be developed.

--While taking measures to develop various modes of transportation, we must quickly strengthen the weak links in the highways, waterways, and air routes to increase their traffic volume. We must take full advantage of the merits of every mode of transportation and form a rational transportation system.

II. Strengthen, Develop New Technologies for Energy Transportation

--The capacity of railways for coal transportation must be enlarged through increased loads. The load of a train will be increased from 3,500 tons to 4,000-5,000 tons, and conditions will be created for it to be further increased to more than 6,000 tons. Special lines for coal transportation should be able to accommodate trains of more than 6,000 tons or possibly 10,000 tons on circuitous but uninterrupted routes.

--Joint land-water transportation should be developed for coal. The capacity of the originating port for collecting, forwarding, and storing, and the capacity of the port of destination for offloading and delivering the coal should be increased.

--Generally, the coal should be dressed and only coal of high heat value should be transported, while peat and coal with low heat value (below 3,500 kcal/kg) should be left behind for local comprehensive utilization.

--Within economically rational distances, we should organize truck transportation from the coal mines directly to the consumer.

--We must step up feasibility studies for slurry pipelines and organize resources to tackle key problems.

--Crude oil will be sent by pipeline to the interior and by coastal and river waterways. For transporting crude oil, we should use high-strength pipelines, raise the traffic pressure, and adopt the technology of automatic control for optimum parameters, the technique of closed transportation, and the technology of reducing the forming of collodoid and to reduce coagulation.

--We should develop pipelines for finished petroleum products, and transport different oil products according to an established order.

--Pipelines for gas transmission should be constructed in the coastal oil fields and in the interior where natural gas is abundant. We should study the technology of moving liquefied natural gas from offshore fields at low temperatures.

--We should reduce the amount of coal ash and the loss of petroleum and its finished products in transit to prevent pollution.

III. Improve Equipment, Increase Passenger Traffic Capacity To Meet Future Development Requirements

--Railways. The number of cars in a passenger train will be increased to 16 or 17 as soon as possible, and to more than 20 on the trunk lines if at all possible. We should trial manufacture new passenger cars to accommodate more people, and develop service between urban and suburban areas. In those sections where passenger traffic is heavy, the construction of special lines may be considered.

--Highways. Motor vehicle passenger transportation should be greatly and rapidly developed. Main efforts should be directed at the development of passenger service between cities, using special diesel buses or other special buses. The construction and improvement of passenger terminals should be accelerated along with the improvement of traffic safety, management, and communications facilities.

--Waterways. The construction of facilities for passenger traffic on main inland waterways should be increased quickly. On routes where passenger traffic is heavy, passenger vessels should be developed. Passenger-cargo vessels should be developed on ordinary routes, while excursion vessels should be developed in tourist areas.

Coastal passenger ships should carry both passengers and cargo. On routes where the distance is short and passenger traffic heavy, high-speed passenger ships should be developed. Passenger docks along the coast should be used mainly for passengers and cargo and for domestic and international trips.

--Aviation. The updating of aircraft should be expedited. The transformation and construction of airports should also be undertaken as soon as possible so that large aircraft can use airports on main routes or in key tourist spots. The daily utilization rate of aircraft must be raised.

IV. Development of Containerized Cargo, Bulk Grain and Cement Cargo, and Refrigerated Cargo

--Containerized transportation should be developed energetically and the required systems set up as soon as possible. Transportation of containers via the "land bridge" should be developed steadily.

--Containers must be standardized and serialized.

--We should actively develop an ocean-going container fleet and open international routes and branch routes for container transportation. A system of collecting and forwarding containers should be established.

--Container transportation by railways should steadily develop in the direction of joint transportation with larger containers and on an international scale. We should also develop special container cars and form consists delivering the container directly to its destination.

--In coastal seas, we should develop small container ships and multipurpose ships. On inland rivers, we should appropriately develop special motorized container barges.

--For container transportation by truck, priority should be given to the development of specialized vehicles and trailers.

--Containerized (panel) transportation should also be developed in civil aviation.

--We should popularize the use of pallets, nets, bags (crates) and so forth for container transportation.

--We should energetically develop bulk shipment of grain and cement and gradually increase bulk shipment of chemical fertilizers, sugar, salt, and vegetable oil.

--Ports should have special grain piers and adopt highly efficient, airtight loading-unloading machines with necessary auxiliary equipment. On inland rivers, there should be barge trains with tight protective covers. Railways should have heavy gondola cars for grain. Specialized trucks should also be suitably developed for bulk grain shipment.

--We should trial manufacture special vessels for bulk cement shipment and build the required docks and loading-unloading equipment. Tipcars will be phased out. In building cement transshipment depots in large and medium-size cities, we should develop mobile drums for bulk cement.

--The transportation of cement clinker should be actively developed. Grinding stations should be built at places of consumption.

--We should quickly trial manufacture and adopt measuring devices required for bulk shipments.

--Refrigerated transportation for highly perishable goods should be developed and improved. A chain of refrigeration facilities should be formed.

--While increasing the number of refrigerator cars on railways, we should vigorously develop mechanized cold storage cars, cold storage cars with new refrigeration sources, and insulated cars. The variety of cold storage and heat preservation cars should be increased. In water transport, we should develop different classes of refrigerated vessels and increase the number of cold storage cabins.

V. Accelerate the Use of Computer Technology, Gradually Modernize Management

--In communications and transportation, the technology of computer application should be used mainly in transportation management, and computer networks should be rapidly established.

--We should pay attention to the study and development of software so as to achieve interchangeability, standardization and modularity as much as possible.

--Each sector of communications and transportation should actively and systematically popularize the computer applications technology.

In the civil aviation sector, computers are mainly used in ticketing, settling accounts, controlling departures, making flight plans, documenting engine maintenance, aviation supplies control, and air traffic control.

In the railway sector, computers are mainly used in traffic control. They are also used for business administration in large marshaling yards and freight depots, and for automatically issuing directions for operation on special coal transportation lines and busy sections.

In the water transport sector, they are mainly used in controlling the movement of containers and for management in water transport enterprises and major ports. A system of water transport control should be established.

In the highway transport sector, computers are mainly used in the automatic traffic control system in the busy sections of national highways.

For urban traffic, they should be first used in the automatic traffic control systems in very large cities and in open cities.

In pipeline transport, we should strive for automation of main pipeline operation.

VI. Accelerate the Reform in Railway Motive Power

--Steam will be replaced by electricity and internal combustion as the source of motive power, which will be mainly oriented toward electricity.

--The electrification of railways must be accelerated. It will start with the major trunk lines used heavily for coal transportation, where increased traction power would yield striking economic results on long, steep grades.

--In other trunk lines and some sections where electrification is still difficult, internal combustion engines will be used for traction.

--Switch engines must use internal combustion engines for traction as soon as possible.

--While motive power is being overhauled, we must continue to use, modify, and repair steam locomotives. Efforts should be made to increase the capability to produce electric and diesel locomotives and power supply equipment. When production of electric and diesel locomotives is adequate for transportation needs, we will terminate the production of steam locomotives.

VII. Accelerate the Technical Transformation and Construction of Railways To Increase Greatly the Overall Haulage Capacity

--Advanced technology must be adopted to strengthen the technical transformation of existing lines and the construction of new lines. For some time to come, the main effort will be directed at transforming existing lines in order to raise the railways' technical standards, to increase their haulage capacity, and to improve their economic results. New lines should also be built, if necessary and if possible.

--To increase haulage capacity, great efforts should be made to increase the load and the number of scheduled trips. The speed of trains should also be appropriately increased.

--On busy trunk lines, we must increase the effective station length from 850 meters to 1,050 meters or even more, as required, as soon as possible. Electric motive power should be used for trains carrying increased loads and as a means to increase the load capacity of ordinary trains. Efforts must be made to increase the percentage of direct [through] transportation.

--We must increase the ratios of double tracks and automatic block systems so that tracking time will be reduced from the present 10 minutes to 8 minutes or less. For single tracks, we should adopt the measures of inserting double track sections, double-tracking parts of them, or double-tracking for one-time use, according to traffic conditions, in order to increase the frequency of trips.

--On trunk lines, we should increase the maximum speed per hour to 120 km/hr or more for passenger trains, 80 km/hr for freight trains, and 100 km/hr for express freight trains.

--The grades of new lines should be determined according to the volume of traffic. If the volume is initially small and grows only slowly, the standard should not be too high. We must take advantage of favorable opportunities for the technical transformation of the lines. In railway construction, we must be particularly careful with the coordination between stations and line capacity, as well as having a complete set of equipment.

--We must develop large freight cars and special cars carrying more than 60 tons, and eliminate miscellaneous models of small cars.

--We must expedite the use of heavy rails. Steel rails of 60 kg per meter must be laid for trunk lines with a total traffic volume of more than 30 million tons a year. At the same time, we must actively trial manufacture rails of more than 70 kg per meter.

--Advanced signaling equipment should be adopted. Busy single-track sections must be equipped for centralized dispatching, and on double tracks, automatic block signals should be used. An automatic direction system should be adopted.

--We should pay attention to the installation of safety devices at grade crossings. At busy crossings, overpasses or warning signs should be provided.

VIII. Increase Port Traffic Capacity, Take Full Advantage of the Merits of Water Transport

--Port construction should be closely coordinated with the economic layout, city planning, and the city's capacity of collection and distribution under a unified plan. The development of the port's own loading-unloading, storage,

collection, and distribution facilities should also be well coordinated. We must pay attention to the construction of small ports, and in using the coastline, we should uphold the principle of reserving deep water for proper use.

--Special berths must be actively developed for coal, bulk grain, and timber. Cargo owners are encouraged to build their own wharves and warehouses. Technical transformation for the old wharves should be accelerated.

--In harbors with favorable conditions, we should raise the proportion of transshipment by water. In the harbors where the berths are not deep enough, barges can be used for load adjustment.

--We should build a modern fleet of rational, economical and safe structure. The proportion of special vessels and new vessels should be raised, and the average service life of vessels should be reduced.

--Transportation of bulk cargo should move in the direction of specialization, while transportation of miscellaneous cargo should be oriented to lot and containerized shipments. Towing operations may be appropriately developed on designated navigation routes, and direct transportation by river and sea should be developed. The development of small vessels should also receive attention.

--Diesel engines should be the main source of propulsion for ocean-going ships. We should select economical sailing speeds, use energy-efficient vessels, and actively develop shallow-draft and self-unloading vessels. We should also systematically popularize engine room automation and adopt new technologies and new communications and navigation equipment.

IX. Strongly Support, Develop Inland River Shipping

--The construction of navigable waterways must be accelerated under a master plan according to unified standards. Their construction and administration should be jointly undertaken by the state and the localities at different levels. The grade-3 courses capable of accommodating 10,000-ton vessels should be called national trunk waterways. The improvement of navigable waterways should be undertaken along with canal construction and trunk waterways should be equipped with electric and automatic navigation beacons. Operational distances for night navigation should be increased.

--In developing and using river resources, we must implement the principle of comprehensive utilization of water resources and ensure an adequate traffic flow.

--We should accelerate construction of inland river ports, increase mechanized loading and unloading, and provide more storage, collection, and distribution facilities.

--We should use advanced vessels. Integrated push-barge trains should be vigorously developed for shipping of bulk cargo in main water systems. When

factors restrict navigation courses, motorized barge trains or barge-tow trains should be developed according to local conditions. We should develop standardized vessels with internal combustion engines.

X. Accelerate the Transformation and Construction of Highways, Develop Motor Vehicle Transport

--All highways in the country should be under differentiated administration. National highways should be built step by step according to the state's unified plans.

--Efforts should be made to develop roads with asphalt surfaces. Highways with a daily traffic volume of 500 vehicles (300 vehicles in areas where sand and rock are scarce) should be surfaced with asphalt. Those with a designed traffic volume of 5,000 vehicles should be surfaced with asphalt and concrete. We should actively develop the technology of road building with emulsified asphalt. Concrete-surfaced roads should be developed in areas with favorable conditions.

--The technical grades of trunk highways should be based on traffic volume. In sections with a daily volume of 6,000 vehicles, different lanes should be assigned for different speeds. High-speed freeways should be built when traffic has reached the designated volume. The allowable load for bridges on trunk highways should be quickly brought up to the standards above grade 15. Consideration should be given to the replacement of ferries with bridges if daily traffic volume exceeds 500 vehicles. The building of new roads should proceed actively, with priority given to broken sections.

--Efforts should be made to improve technical and economic properties, to readjust automobile structures, and to raise the proportion of heavy duty trucks. By 2000 the proportion of heavy duty trucks for freight transportation should be above 10 percent. We should also actively develop light vehicles and various types of remodeled and special-purpose vehicles, and gradually raise the proportion of light vehicles. While actively developing passenger buses, we should also systematically develop sedans.

--The proportion of diesel vehicles should be raised. Trucks of more than 8 tons should have diesel engines which may also be appropriately used by vehicles of about 5 tons. Light vehicles should mainly use gasoline, but those for export or rural use can be equipped with diesel engines.

--Trailer transport should be developed. Particular attention should be paid to the development of saddle tractors, semitrailers and special-purpose trailers.

XI. Development of Air Transport

--Using the foundation of the domestic aviation industry, we should import advanced foreign technologies and gradually become self-sufficient in civil aviation.

Special-purpose aircraft, helicopters, and transport planes for short-distance flights or for feeder lines should be quickly improved or modified to give them better technical and economic properties and so they can be independently produced in China. We must increase the numbers and standards of Chinese-made aircraft for domestic main route service and new generation feeder line aircraft.

--The length of time for aircraft replacement should be reduced, and an economically rational time span for their depreciation should be determined in terms of years instead of hours.

--Airport runways should be upgraded and their class elevated. Runway surfaces should depend on local conditions, a combination of "hard" and "soft," with a transition to the "soft."

--We should establish an automatic air traffic control and dispatching system, an instrument landing system, and an automatic communications network, so that ground equipment will be compatible with an aircraft's instruments and meters.

--Maintenance should be improved. The system of inspection and disassembling for repairs at fixed intervals should be replaced by that of a combination of periodic inspection, repair as circumstances dictate, and monitoring.

--We should raise the standards of mechanization and automation of ground facilities, improve ground services, and reduce the time during which an aircraft remains at a maintenance facility.

XII. Improve Rural Communications and Transportation

--Efforts should be made to build and repair rural roads. Construction of these roads should be included in unified plans for developing mountainous areas, water, forests, farmland, and villages.

--Motor vehicle transportation between urban and rural areas should be actively developed. Other means of agricultural production, such as tractors and transport vehicles, should also be developed.

--Small and medium-sized high-performance vehicles, and various types of specialized vehicles and trailers should be developed according to the characteristics of rural transportation.

--We must fully utilize water transport, developing both motorized and sailing vessels for agricultural roles.

XIII. Strengthening Urban Communications and Transportation

--We must accelerate the development of a system of grade-1 and grade-2 highway arteries in large cities. For the very large cities, a system of high-speed freeways should be phased in. Interchanges should be improved, and, where necessary, overpasses, parking lots, pedestrian bridges and tunnels should be built.

--Urban public transportation should be energetically developed. Today, public vehicles and trolleybuses are mostly used, and taxi service is being developed. In particularly large cities, we should develop high-speed rail transportation. A comprehensive system of variegated and three-dimensional transportation systems will be formed so that more city residents will be induced to use public transportation. The use of private vehicles will be restricted even in large cities.

--We should pay close attention to transportation between cities and suburbs. There should be joint use of motor vehicles and trains, and in the particularly large cities, commuter lines between urban and suburban areas should be built. Joint freight shipping centers should be formed in the outskirts so as to increase the turnover and efficiency of moving freight.

--Joint transshipment should be well organized.

--Traffic control should be further modernized. For urban traffic control, we should adopt the system of points, lines or areas of control according to local conditions. In particularly large cities, communications centers should be set up to monitor traffic.

Section Three

Main Points of Telecommunications Technology Policy (Excerpts)

I. Development of Telecommunications Network Technology

--The public telecommunications network is the main sector of the state's telecommunications network, and great effort must be made to develop it. Provided social benefits and improved economic results can be assured, we must actively develop suitable advanced technologies to increase our telecommunications capacity so that a modern telecommunications network with high standards of quality, efficiency, and professional competence in the transmission of telephone messages, telegrams, data, facsimile, images, and broadcasting and television programs will emerge. Priority should be given to the development of the telephone network.

China's long-distance analog network is already in a fledgling stage, and its analog telecommunications technology is fairly mature. China is now capable of mass producing the required equipment in complete sets, and should continue to develop it and improve its quality.

Digital telecommunications can be easily condensed, it is strongly interference-proof and based on advanced technology with a promising future. It should therefore be actively and systematically developed.

Both digital and analog telecommunications will continue to coexist in China for some time. In developing telecommunications technology, we should adhere to the principle of multilevel and selective development, coordinating many different methods. All regions should decide on their own method of development according to their social demands, economic conditions and technological capability.

For international telecommunications, we should adopt new technologies and new equipment to introduce new services. Satellites and submarine cables should be used mainly for the international circuits, while shortwave, microwave and power cables should be used by individual regions. Outbound international telecommunications should be routed through the international bureau, while the activities of border bureaus should be confined to communications with adjacent countries and regions. The international bureau's exchange system should be gradually changed from that of manual operation to that of semiautomatic or fully automatic operations, and program-controlled digital switching units should be used. The properties of interfacing and the standards of transmission in international telecommunications must conform to the relevant recommendations of the International Telecommunication Union and the stipulations concerning the technological system of the domestic telecommunications network.

The center of communications in the telecommunications network should have a rational layout with a combination of both wired and wireless equipment and the coexistence of digital and analog facilities until comprehensive optimization can be achieved.

--Each of the special telecommunications networks should have its own key features.

Railways should have wired communications supplemented by wireless, and phase in a long-distance telephone network with an automatic exchange system. Efforts should be made to digitalize this system and to enlarge its capacity.

Power transmission will mainly rely on microwave and power carrier waves. In some key spots, digital program-controlled switching should be developed.

At sea, we should use wireless communications with ships, and at harbor communications centers, we should develop low-capacity microwave and leased public long-distance circuits. International maritime satellites should be used to develop ship-to-shore communications and to improve the mobile telecommunications network at sea.

Broadcasting and television will be conducted via satellite and ground microwave communications systems.

For petroleum [industry] telecommunications, a communications system should be formed by the use of leased satellite circuits together with microwave circuits along pipelines.

--The development of public and special telecommunications networks should be closely coordinated.

--We must proceed from reality in the modernization of telecommunications. In addition to fully tapping the potential of existing facilities, and upgrading them, we must also adopt new technologies and new equipment.

--Wireless communications should be rationally developed and fully utilized within the frequency bands allocated under the state's overall arrangement. Its operation should be strengthened and well coordinated with that of other bands.

--Standardization, serialization, and interchangeability should be strengthened, and international standards as well as advanced foreign standards should be adopted.

Technological standards for the state's telecommunications network should be established as soon as possible. Before the promulgation of these standards, the standards of special networks should be the same as those of the public network, if at all possible.

The technical systems and standards of the public telecommunications network must be made uniform as soon as possible. First, we must set up the systems and standards for the analog network, the mixed analog-digital network, and the digital network, and then study and set up the systems and standards for the operation of comprehensive digital network services.

When all communications equipment and special networks and lines are connected with the public network, they should be able to meet merging requirements.

II. Telephone Network

A telephone network, as the main component of the telecommunications system, must be developed rapidly. We must strive to attain the following goals by 2000: The units' need for telephone service will be basically met; the use of public telephones will be more universal; and there will be a certain number of telephone sets for household use. A unified and automatic telephone exchange network will be gradually formed in the country, and the use of telephones will be greatly increased. In most of the cities above the county level, long distance calls can be made by automatic dialing, and the telephone network can be used for many other services, such as the transmission of telegrams, facsimile, and data.

--Automation should be introduced in most urban telephone networks. The users' telephone exchanges should be developed in close coordination with the city network. In the large and medium-sized cities, manual switching units and most of the outdated and backward equipment under the rotary and step-by-step systems should be gradually eliminated.

--The telephone networks should have grade-5 exchange structures. Exchange centers should be established according to the volume and flow of traffic, and, if necessary and at all possible, direct circuits should be formed.

--Programmed digital exchange units represent the trend of development and must be actively developed. They should be first used in particularly large cities and open cities, and be developed in large cities and economically-developed regions according to local requirements and comprehensive results.

Cross-bar switching units should be in batch production in China, and we should transform and continue to develop them.

--We should develop and popularize standard sets, new electronic sets and digital sets of telephones, and phase out obsolete and backward sets as soon as possible.

--We should develop mobile telecommunications and the calling service.

In the countryside, there can be two standards and variegated equipment for telephone service according to local conditions. Economically developed rural areas should adopt the standards of trunk line communications which will be gradually included in the main network. Ordinary rural areas should adopt the standards of rural communications which may also join the network. The telephone exchanges used may be either manual, semiautomatic, or fully automatic according to local conditions.

III. Telegraph and Digital Networks

--For the public telegraph network, the grade-2 exchange network structure should be used. We should develop and popularize the use of program-controlled automatic switching, time-division multiplex equipment, and electronic transmitters, and develop the system of public telegraph transmission with city telephones and telexes. Grade-3 exchange networks should be used for telex networks.

A major effort should be made to develop the data transmission network. We should use the telex network for developing low-speed data service, and the automatic exchange network of public telephones for developing medium-speed data services.

We should actively develop data group exchange technology and set up a national public data transmission network. With uniform interface standards, we will form a link between private and public data transmission networks.

IV. Image Transmission Network

--Facsimile communications

Telephone circuits should be used for subscribers' document facsimile services. We should also develop international and domestic public facsimile document services.

In the near future, we will popularize class-2 facsimile machines as soon as possible, while developing and popularizing class-3 machines. By 2000, we will have class-4 high-speed facsimile machines and their storage exchange system. We will also popularize the use of supergroup transmission for newspaper facsimile and develop a compressed digital frequency band system for newspaper facsimile.

--Image communications

We will appropriately develop static image communications in the telephone network.

If necessary and at all possible, we should use the public telephone network or the digital network to develop new types of image and information transmission. By 2000, bi-direction visible data and image communications will be developed mainly in large cities. TV coverage of meetings will also be appropriately developed.

V. Transmission Technologies

--For telecommunications transmission, we should, before 1990, popularize the use of new city telephone cables and speed up the practical use of optical cables. We will also adopt pulse coding technology and appropriately develop city telephone carrier wave. Before 2000, we should actively develop and popularize optical cable and digital transmission technologies. Continued efforts should be made to improve other means of transmission.

--For long-distance communications, various technologies should be adopted according to local conditions. By 1990, we must actively popularize satellite communications, develop long-distance and high-capacity optical cable systems and digital transmission technologies, and continue to develop cable carrier wave and microwave communications so that by 2000 there will be great developments in optical cable and domestic satellite communications. At the same time, we should appropriately develop power cable carrier wave and microwave communications.

--For rural telecommunications, we may generally adopt new types of plastic cables and other economically suitable means of transmission. In economically developed areas, we can use trunk line transmission.

--Scope of application of transmission technologies and direction of development:

Cable carrier wave: For long-distance trunk lines, we may, according to existing conditions, adopt various types of small and medium-size coaxial cables and balanced cables. As for those cables which have already been laid, we should expand their capacity and develop repeater carrier waves.

Microwave communication: We should use microwave systems of large and medium capacity for trunk lines, and should use mainly microwave systems of small and medium capacity for branch lines. We should also develop digital microwaves as well as new and even higher frequency bands.

Optical cable communication: We should selectively develop long wave and long optical cable systems, increase the reliability of the optical components and lower costs. In the near future, we should phase in multimode optical cables beginning with urban telephone systems. The development of monomode optical cables will be the trend for long-distance transmission.

Satellite communications: We should actively develop domestic satellite communications. We should also develop the digital satellite communications technology, and while developing large ground stations, we should also develop small and medium-sized ones.

Open wire communications: In the near future, we should further increase the reuse coefficient of overhead open wires, enlarge their capacity and, if conditions permit, systematically transform them into power cables or optical cables.

Ultramicrowave communications: This should be used for mobile communications, wireless call systems, and inter-island and local communications in fixed locations.

Short wave, long wave and ultralong wave communications: This should be used as required in business. We must make good use of existing equipment as much as possible.

VI. Communications Safety and Security

--While setting up communications and power circuits or building electrified railways, we must choose the rational sources to prevent interference. Effective precautionary measures must be taken in case of difficulty or continued existence of interference.

--National standards must be set up for electromagnetic compatibility to prevent industrial interference and the mutual interferences of electronic equipment.

--In designing and using communications equipment, we must take the necessary measures to ensure safety.

--We should attach great importance to communications security. We must firmly adhere to the principle of ensuring the smooth flow of communications and maintaining security. Security technology must be actively developed for communications and the research in and production of security equipment must be stepped up, especially for the security equipment of users.

VII. Development of Postal Network

--The organization of a postal network must be based on a rational demarcation of postal zones and the use of postal codes. The use of these codes is in line with the trend of development, and effective measures must be taken to popularize their use.

--A central bureau should be set up for sorting and distribution.

The present sorting and distribution network must be transformed and the demarcation of postal zones must be carried out under a unified plan. In each postal zone, there should be a central bureau for mail sorting, and a system of sorting, distributing, and forwarding from one central bureau to another.

Uniform standards should be set up for bureaus at every level with regard to their size, production process, and technical equipment. All equipment, tools, envelopes, and mailboxes must be standardized and serialized. Mail specifications should be gradually worked out.

The establishment of central bureaus and the urban post offices should be included in urban construction plans. New high-rise apartment buildings must be equipped with banks of mailboxes, while all old urban houses should have individual mailboxes.

--A postal network using various means of transportation should be set up.

A postal network using different modes of transportation and at different levels should be set up according to the principle of guaranteeing timely delivery via the best route.

Mail transportation along the trunk lines should be carried out mainly with the state's means of transportation and should be included in the state plans. Communications and transportation departments should guarantee certain space for mail and grant certain preferential rates.

Air mail service should be actively developed.

A postal transportation network with the use of large trucks, trains, and ships for heavy items should be developed.

--Development trends in postal technology:

Letter processing: A coding system with both manual and automatic equipment should be developed. In post offices with medium volume, sorting can be done with push-button equipment.

Parcel processing: Central bureaus with fairly heavy traffic will use highly efficient sorting equipment with many forms of information input and many slots.

Distribution of printed matter: Computer processing will be used for the collection of data, and mechanized equipment will be adopted step by step for distribution.

Trunk line transportation: The use of containers will be introduced with mechanized loading and unloading during transfer.

Postal savings and remittances: A special data network for both postal savings and postal remittances will be set up.

Systems of computer data verification for remittance, postal dispatch, and information feedback will be set up step by step.

Section Four

Main Points of Certain Technology Policies on Agriculture (Excerpts)

I. Gradual Establishment of a Rational Agricultural Technology Structure To Promote Commodity Production

For agricultural development, we must pay attention to the development of all land that can be utilized, and make every effort to raise the productivity of land and labor. While developing agricultural production, we should also develop rural industry and rural commerce so that the rural economy, consisting mainly of crop farming will gradually undergo a comprehensive development of agriculture, forestry, animal husbandry, sideline production and fisheries. Coordinated operations between agricultural, industrial, and commercial departments will accelerate the transformation of the economy from one of self-sufficiency or semi-self-sufficiency in agriculture into one of large-scale commodity production, and from traditional to modern agriculture.

To promote the readjustment of the rural economic structure, a rational agrotechnology structure should be formed. We should choose those technologies that are consistent with conditions in China, gradually increase technology-intensive production, and continue to raise the proportion of semimechanization, mechanization and automation. We should focus on combining biotechnology with engineering technology, and on combining traditional with new technologies.

--We must uphold the principle of combining the exploitation and utilization of agricultural resources with their conservation and improvement. Input must be sufficient to support the constantly increasing output, and the regeneration of resources should be able to offset or to surpass their consumption, so that the farmland, forests, pastures, and water areas can be continuously utilized, and a benign cycle of production that is free from any form of control can be formed.

--We should develop technologies for the multilevel utilization of agricultural resources. We should also pay attention to three-dimensional agricultural technology and develop technologies for the multilevel and comprehensive utilization of farmland, forests, pastures, water areas, and other spaces for production.

--We must develop equipment and technologies consistent with the scope of business operations. In the near future, we should focus on the development of equipment that is compatible with the scope of operations of specialized households as well as the extent of their development.

--We must improve the quality of agricultural products and processed products, set up rational quality standards, use better means of testing, and strengthen the testing system.

--We must determine channels of technological development, and exploit and popularize suitable technologies according to local conditions.

--We must study and popularize scientific management technology, strengthen the information transmission and market forecast systems, pay attention to the economic results, and provide technical training and technical services in order to improve management.

--We should attach importance to the coordinated application of technologies. We must organize the collective use of single technologies properly according to local conditions in order to achieve comprehensive efficiency.

--We must actively and systematically develop applied computerization, biotechnology and remote sensing technologies.

II. Practice Intensive Planting To Raise Per-unit Output and Improve the Quality of Crop Farming

--While actually guaranteeing a certain grain output, we must continue to readjust the internal proportionate relationships of crop farming according to the characteristics of the agricultural zones, so as to form a rational structure for the coordinated development of grain, fodder, and cash crops. The production of beans must also be developed.

--We must fully utilize the merits of each region, actively support the establishment of commodity bases, and gradually raise the standards of specialization, socialization and commercialization in production.

--Areas of high, medium, and low yields should be treated differently. For a set period of time, the potential for higher per-unit output will be in low-yield areas. The key lies in the use of suitable advanced supportive technologies. We must radically improve low-yield areas by changing their conditions of production and ecological environment. We must also energetically improve economic results of high-yield areas, tap their potential, and continue to raise the levels of commercialization and modernization.

--Intensive planting must be practiced, and the material input, especially that of chemical fertilizers, pesticides, and other agricultural chemicals, must be increased. We should also improve irrigation facilities and selectively increase the number of agricultural machinery and equipment.

--We must integrate the utilization and conservation of land, and rotate crops properly. In areas where conditions permit, we should also adopt interplanting, undersowing, and multicropping systems.

--In accordance with the ecological characteristics of different areas, we should adopt different methods, including the use of advanced technologies, to select and breed fine strains, with particular emphasis on the quality and power of resistance. We should also form an integrated system of scientific research and production for the specialization and commercialization of fine strains, and to support specialized households. The technology and system of seed inspection should be improved and perfected, and the seeds quickly standardized.

--We should strive to enlarge irrigated areas, and pay particular attention to the development of irrigation technology, and we should strengthen the engineering support for farmland. The low-cost, low-energy consumption technologies of irrigation by spraying, instillation, and infiltration, and the use of soft tubes should be developed to raise the water utilization rate. In lowlands where frequent water-logging may occur, we should pay attention to drainage and flood prevention technologies. In arid land where irrigation facilities are not available, we must actively adopt moisture conservation and rain water retention technologies as a precaution against drought. We should scientifically review and popularize technology which has been proved to be effective in increasing agricultural output under drought conditions.

--Research in fertilizer application must be strengthened, and a system of technical service in rational fertilizer application should be set up. We should use the amount of plant nutrition and the result of soil analysis as criteria to evaluate its effectiveness.

--We should make greater efforts in the trial manufacture and production of pesticides of high efficiency, low toxin, and low residue, and pay attention to their safe and proper use. We must develop biological techniques in the comprehensive prevention of pests, weeds, and rats.

III. Combine Inorganic With Organic Fertilizers, Accelerate Chemical Fertilizer Production

--We should accelerate fertilizer production. While continuing to develop nitrogenous fertilizer, we should also make efforts to develop phosphate and potash fertilizers.

--The organic properties of soil must be increased, and the use of organic and inorganic fertilizers must be used in proper proportion. The techniques of making, preserving, and applying fertilizers should be improved.

--We must develop new varieties of green fertilizers and improve the methods of their planting and utilization.

--The effective ratios of nitrogenous, phosphate, and potash fertilizers for application throughout the country should be changed from 1:031:0.05 by 1983 to 1:0.5:0.2 by 1990, and, hopefully, to 1:0.6:0.3 by 2000.

--We should change the present make-up of chemical fertilizers in order to increase their effective components. The ratio of low-density fertilizers, such as ammonium carbonate, should be gradually reduced, while that of urea, concentrated calcium, and other single substance fertilizers should be raised. In the areas with phosphate and sulphate resources, we should build large phosphate fertilizer plants or compound fertilizer plants.

Existing enterprises should conduct technical transformation centering on the reduction of energy consumption, improvement of quality and economic results, and prevention of environmental pollution.

--Prospecting of soluble potassium resources should be strengthened, and the construction of the Chaerhan potash fertilizer base in Qinghai should be accelerated.

--Trace element and microbial fertilizers should be systematically produced and purposefully applied.

--We should improve the circulation, storage, transportation, and care of chemical fertilizers in order to reduce losses.

--We should carefully attend to the work of checking and evaluating chemical fertilizers.

IV. Restrict Felling, Accelerate Tree-planting, Develop Fast-growing, High-yield Forests

--The development of new forest areas and the restoration and transformation of old ones must be accelerated in order to promote the rehabilitation of over-timbered areas.

--We must develop and use existing forests carefully, determine the amount of felling and prohibit felling in designated areas. Indiscriminate felling is strictly forbidden.

--Land resources must be fully utilized, and forest areas must be expanded. We must make careful plans for the forest areas and the types of trees to be planted according to local conditions, and make overall arrangements for various types of shelterbelts, timber forests, economic forests, and firewood forests.

--We should accelerate the greening of barren mountains and desert beaches. We should also plant trees, shrubs, or grass according to local conditions, and adopt active measures for aerial seeding and seal off mountains to promote afforestation.

--We must actively develop fast-growing, high-yield forests. We must also select fine strains and sturdy seedlings for intensive rather than extensive planting, strengthen their management, prevent or eliminate pests and weeds, and, in localities where conditions permit, apply suitable fertilizers and adopt irrigation measures.

--We should plant trees on "four sides" in the plains. Farmland shelterbelts should also be created, and, if conditions permit, there should be interplanting of trees and crops.

--We should actively prevent pests, and be better able to anticipate and forecast forest fires to take remedial measures.

V. Pay Attention to Comprehensive Utilization of Timber, Change the Timber Product Mix

--We must develop comprehensive utilization of timber, carry out multilevel processing, change the timber product mix which consists mainly of logs, and gradually raise the proportion of timber, semifinished products, and artificial board.

--Lumbering must proceed from comprehensive economic results, and processing must be carried out in accordance with the required varieties and specifications. The quality of processing must be improved and the timber output increased. For comprehensive utilization, forest areas must make good use of whatever is left over from felling, bucking, and processing.

--For raw materials required in producing plywood, we should increase the resources of tree species and at the same time continue to make use of small-diameter logs and to plant fast-growing species.

--We must vigorously develop particleboard, improve fiberboard, and actively exploit plywood. All artificial board products should continue to develop with better quality, greater variety, and more specifications.

--Active efforts should be made to produce more plywood and to fully utilize small-diameter logs, timber from intermediate felling, low-quality timber, and the short and small-sized timber.

--We should develop various types of special adhesives. We should actively develop the specialized production of concentrated prepolymer and glue in powder form.

--We should work to develop the technology of surface decoration of artificial board to improve the quality of surface decorations and to offer more designs and varieties.

--Wood and bamboo resources from wood chips, small-diameter logs, bamboo, and fast-growing trees must be fully utilized as raw materials for papermaking. The technology for the use of saw-dust and bark should also be developed.

--We should energetically study and popularize the technologies of protecting timber and artificial board from rotting, and against pests and fire.

VI. Strengthen the New Fodder Industry, Promote the Development of Animal Husbandry

--The structure of animal husbandry should be readjusted. We should actively increase the number of lean-meat hogs and raise the efficiency of hog raising. Provided the present pork output can be increased, we should appropriately lower the number of hogs in stock. We should also develop laying chickens with a high feed conversion ratio, meat chickens, and milk cows so as to raise the proportion of herbivorous animals.

--We should work out a new system and layout for the feed industry. Attention should be paid first to the production of various materials for compound feeds. Such production should be consistent with the development of animal husbandry.

The state should produce vitamins, trace elements, amino acids and various additives at designated locations. Large and medium-sized cities and raw material production areas will produce mainly protein concentrates and premixed feed, while the small rural feed plants should devote their main efforts to producing compound feeds using local feed resources and the aforementioned items produced and supplied by the state.

--Quality and sanitary standards should be quickly established for feed and various materials.

--Efforts should be made to broaden protein feed sources, and to raise the ratio of rice dregs that can be used as raw material. We must also actively develop the comprehensive utilization of leftover materials.

--Modern biology and chemical engineering should be applied in the production of amino acids, vitamins, minerals, various additives, nonprotein nitrogen, and single cellular protein.

--The use of rice husks, which are of no nutritional value, as feed should be stopped.

--We should popularize silage technology, and its preservatives should be developed.

VII. Develop Fresh Water and Marine Aquiculture, Improve Aquiculture Technologies for High Yield

--Our main objective is to accelerate growth and shorten the breeding period. We should also improve breeding methods and develop aquiculture technology.

--We should actively expand breeding areas and transform water areas so that their productive capacity can be increased.

--We should develop granular feed used specially for aquiculture and actively produce feed from both land and water sources. Leftover materials from agricultural and animal husbandry products and discarded marine materials must be locally processed and used for fish feed.

--We should develop a comprehensive technology for both treatment and prevention, with greater emphasis on prevention, and the use of biological methods, immunization, antibiotics and drugs.

--We should strengthen the cultivation of fine breeds, develop the technology of industrial seedling production, and popularize the use of improved varieties.

VIII. Strengthen the Work of Storing Farm Products, Keeping Them Fresh, Processing and Comprehensive Utilization

--Active technical guidance must be provided to reduce the loss of farm products after production.

--We should energetically develop the multilevel processing and comprehensive utilization of agricultural by-products.

--State granaries should be properly distributed according to the economic zones and the grain flow. New types of granaries should be developed in accordance with local conditions.

--Methods for procuring, storing, and transporting grain should be improved and the old stock should be removed from the granaries in time to make room for the new. The method for transporting bulk grain should be actively developed.

--We should make rational readjustments in geographical distribution, the scale of production, and the product mix of grain and oil processing plants. We must energetically develop thorough processing of grain and oil, and increase the varieties.

--Based on the characteristics of different zones, we will plan for the establishment of a number of special production bases that are suitable for the balanced supply, storage, and processing of vegetables and fruit.

--We should actively develop the processing of vegetables and fruit as commodities, and phase in a comprehensive system of purchasing, grading, packaging, prefreezing, storage, and shipping with a chain of refrigeration facilities.

For vegetables and fruit, we must set up storage facilities at the place of production and make full use of natural cooling sources, develop and perfect the storage facilities which have been proved to be effective in various localities, and build cold storage and air-conditioned facilities.

--We should make great efforts to process vegetables and fruit into semi-finished and finished products at the place of production.

--Packaging should conform to specifications and standards.

--We should attach great importance to keeping ocean products fresh and to processing them. Refrigeration facilities should be set up at each link from production to marketing to form a refrigeration network. Fish of low value, small fish of various kinds, shellfish, and algae should be comprehensively utilized.

--For the production of animal products, we should ensure priority in the supply of raw materials for existing processing plants in order to develop the processing industry for animal products in herding areas.

--Grades and standards must be properly set up for agricultural products and their processed products, and the technology and means of testing must be developed.

IX. Improve Equipment for Agriculture and Rural Enterprises

--Proceeding from China's national conditions, we must adopt a multilevel technical structure and actively develop the equipment and means of production for agriculture, forestry, animal husbandry, sideline production and fisheries as required by the rural enterprises. We must also improve their quality and properties, increase their varieties and reduce their energy consumption.

--Farm equipment can be any size, but mostly should be medium and small-sized, and be either mechanized or semimechanized. They must be suitable for different natural conditions, economic conditions and production conditions and be able to meet the needs of different operations and different scopes of production. While supplying small and medium-sized equipment to the peasants, we should also appropriately develop heavy equipment according to the needs of state farms, special agencies serving agricultural mechanization, and large irrigation projects.

--More farm equipment should be produced in complete sets. We must set energy consumption standards for key equipment, develop equipment for energy conservation, and systematically renovate or eliminate outdated equipment with high energy consumption.

--We should raise the technical standards of farm equipment, make operation safer and more comfortable, and reduce noise and exhaust pollution. The interchangeability, standardization, and serialization of the equipment should be raised and international standards should be adopted.

--For farm equipment, we should strengthen information supply, marketing, maintenance, technical training, and popularization through demonstration in addition to technical services.

X. Strengthen the Conservation and Management of Natural Agricultural Resources

--After checking up on the land resources, we should formulate plans for land utilization and properly readjust the pattern of utilization.

--Peasants should be encouraged in land investment and the land should be used as well as protected.

--Indiscriminate use of farmland is strictly prohibited, and the use of land for construction must be strictly controlled. In the countryside, we should encourage the building of multistoried houses. The use of farmland [for construction] should be minimized.

--Wasteland suitable for agriculture should be reclaimed in a planned and systematic way. As long as the resources of marine production are not destroyed, beaches may be enclosed for cultivation. Land reclamation for farming in lakes is prohibited.

--Conservation of water and soil must be stepped up according to the principle of equal importance for prevention, improvement, and management and comprehensive planning for general improvement according to local conditions. Reclamation of mountain slopes is prohibited.

--Water resources must be well protected and managed. We must develop underground water properly, strictly forbid the use of deep-strata water, strictly control the number of wells to be sunk, and make good use of waste water.

--Conservation of biological resources: Nature preserves must be established to save rare animals and plants that are on the verge of extinction.

--Conservation of forest resources: The rate of felling must not exceed the rate of growth. Indiscriminate felling and land reclamation through forest destruction is strictly forbidden.

--Conservation of pastures: Indiscriminate land reclamation and indiscriminate herding are prohibited. Herding must be based on the availability of grass, and excessive grazing must be restricted. Precautions should also be taken against pasture deterioration.

--Conservation of aquatic resources: Reckless and indiscriminate fishing is strictly forbidden, and pollution of water areas must be prevented.

--The survey of agricultural resources and the demarcation of agricultural zones should be continued.

Section Five

Main Points of Technology Policies on Consumer Goods Industry (Excerpts)

I. Guiding Principle on Development of China's Consumer Goods

--In producing consumer goods, we must strive to satisfy the ever increasing needs in people's material and cultural lives. Production must be compatible with people's increased purchasing power and changing consumption patterns.

--People's consumption should be consistent with China's national conditions and a fairly good standard of living. It must be able to satisfy the people's needs and to lead them in the correct direction of development and enjoyment.

--Based on a multilevel consumption pattern, we should develop popular, middle-grade, and high-grade products to satisfy people's needs at different consumption levels in both urban and rural areas.

--Active efforts should be made to open new fields of consumption. While energetically developing household consumer goods, we should also strive to supply products for various public undertakings.

--In producing consumer goods, we must rely on technological progress, actively carry out technological transformation, and adopt new technologies and equipment to produce high-quality products and good economic results.

--We should attach great importance to the quality and property of consumer goods. We should actively develop new products, increase designs and varieties, and improve product series. We should also pay attention to the scientific and economic aspects, the practical utility, safety factors, aesthetics, and the supply of easily marketable consumer goods.

--We must fully and properly utilize all resources in intensive processing and comprehensive utilization of products.

--The development of the consumer goods industry must be coordinated with urban and rural developments.

--We should make great efforts in personnel training and in increasing intellectual investment in order to raise the percentage of technicians in the personnel departments of the consumer goods industry.

II. Strengthen the System of Producing and Supplying Raw Materials for the Consumer Goods Industry

We must make great efforts to improve the quality of raw and semifinished materials, to develop them, and to further strengthen their production and supply systems so that there will be a base for the production of high quality and serialized raw and semifinished materials with standardized specifications. For agricultural raw materials, we must choose, cultivate and popularize outstanding varieties that are suitable for processing and set technical standards that meet industrial production requirements.

--We must energetically develop animal protein resources and fully utilize China's abundant plant protein resources.

--There should be diversified varieties of grain and edible oil of different grades. We must actively develop high-quality rice, high-quality flour, graded flour, refined oil, and special fats and oils for the food industry.

--Different brands of special starch should be produced, with particular attention to the comprehensive utilization of tuber resources.

We should develop the feed industry and set up commodity bases for the production of poultry, animal, and aquatic products, reform and popularize breeds of high-quality pigs, cattle, and sheep for their meat and skins.

--We should greatly develop sugarcane and beetroot and increase the percentage of the latter. We should set up their production bases according to a proper layout, and raise their per-unit output and sugar content.

--We should develop various types of amino acids, enzyme products, and other food additives.

--Production bases should be set up for canned foods, beverages, liquor and cigarettes. We must also cultivate, import and popularize the outstanding varieties that are suitable for processing. We should fully utilize uncultivated resources and we should cultivate and change some strains of economic value. We should set up stable bases for their production and supply.

--We should cultivate and popularize fine cotton strains. The quality of cotton should be improved and fiber strength increased. Different fiber lengths should be rationally proportioned.

--We should improve sheep breeds and quickly raise more fine-wool and medium-wool sheep. To improve the quality of wool, we should pay more attention to long strands and increase their evenness, strength, and elasticity. Rabbit fur should be developed in a planned way, and continued efforts should be made to raise the proportion of washed fur. We should actively promote the method of assessing value on the basis of pure hairs and having direct contact between industry and animal husbandry.

--We must actively raise and popularize the outstanding breeds of silkworms and increase the quality and output of silk.

--We must develop varieties of the tawny daylily with a fiber count of more than 1,500, and suitably raise the proportion of raw flax with a count of more than 1,800. We should also properly readjust the area for growing jute and flax and raise the proportion of jute. Flax and huma resources should be fully utilized.

--We should further develop chemical fibers and raise the percentage they hold among raw textile materials. Chemical fibers should come in many varieties and specifications. Efforts should be made mainly for the development of synthetic fibers and the suitable development of artificial fibers. We should raise the proportion of long terylene fibers and improve their quality in addition to developing new varieties of chemical fibers and functional fibers.

--We must develop the production of dyeing chemicals, additives, pulp, and grease, and quickly serialize these products.

--We must accelerate the building of fast-growing and high-yield forests for the paper-making and artificial fiber industries, make good use of wood fragments, and continue to increase the proportion of wood pulp. We must also attach great importance to bases established for reeds, bamboo, and Chinese alpine rush to be used for paper-making.

--We should increase the output of synthetic resin and additives commonly used to meet the requirements of plastic processing, and properly readjust the product mix.

--We must properly utilize petroleum materials and natural grease, energetically develop the production of alkylbenzene, fatty alcohol and its derivatives, such as alcohol, ether, and detergents.

--We must study and develop new varieties of synthetic perfume and concoct new types of essences.

--Raw materials for ceramic and glassware in daily use should have quality standards and be classified and graded. They should be supplied at designated points according to the required quality standards.

III. Readjust the Product Mix, Develop New Products To Meet Social Demand

Consumer goods should be developed according to market demand and in proper proportions. In food, nutrition and hygiene should be the dominant factors, although attention should be also paid to coloring, smell, taste, and packaging. Textile products should be of rational proportions and have a complete assortment of varieties and novel styles. For articles of daily use, we should pay attention to the updating of designs and varieties. Durable consumer goods should be safe, reliable, durable, energy-efficient, well-designed and multifunctional. We should focus on the production of spare parts and accessories, as well as maintenance service.

--The food pattern should be promoted on a social scale. We should develop an industrialized system to produce staple and nonstaple foodstuffs as well as prepared and convenient food.

--We should actively develop foodstuffs for infants, children, and old people as well as high-nutrition food.

--For beverages, we should make special efforts to develop fruit juice, protein and fermented drinks, drinks prepared in solid form, and wholesome drinks with unique Chinese characteristics.

--We should systematically develop various kinds of low-alcohol-content wines and increase the percentage of high-quality wines. We should also develop low-tar and low-nicotine cigarettes and raise the percentage of filter-tip cigarettes.

--We should develop food additives and traditional food, improve the quality and increase the variety.

--We should raise the ratio of chemical fiber textile products and develop various types of blended, pure, and interwoven chemical fibers and new plush textile products.

--We should actively develop new textile products of pure wool and silk, increase their crease-resistant, sanforized and press-free properties, improve their tactile quality and raise the ratio of high-grade products.

--We should raise the proportion of fabrics for household and decorative uses. In the near future, our main efforts will be directed to the development of bedding, window curtains, and furniture covers, along with the production of wall paper and nylon carpets.

--New textile products for industrial use should be developed.

--The ratio of knitwear should be raised and the product mix of machine-knitted and ordinary knitwear should be readjusted.

--The properties, appearance and tactile quality of textile products should be improved through mechanical and chemical processing.

--We should take advantage of China's cashmere, rabbit fur, yak, camel's hair, etc., and other fiber materials to develop new products and to intensify the processing of same.

--We should vigorously develop the industrialized production of garments, shoes and hats, improve designs, and increase the specifications, sizes, colors and styles.

--For clocks and watches, bicycles, and sewing machines, the main requirement is to increase the number of designs and varieties and to improve quality.

--Active efforts should be made to develop new sources of electric light and new types of lamps.

--Electric appliances such as refrigerators, clothes washers, and electric fans should be developed in a planned way. In addition to household models, we should also develop those oriented to society. Electric appliances for use in the kitchen, for improving personal appearance, and for cleaning and sanitation should be selectively developed.

--In the development of electronic consumer goods we should attach particular importance to color TV sets and cassette recorders. We must continue to lower costs, improve the quality and properties, and make them more widely accepted.

--We should accelerate the modernization of cameras.

--While developing light-sensitive materials, we should also pay attention to the development of color film.

--We should develop high storage capacity batteries, rechargeable batteries, and microbatteries. The varieties and specifications must be correct for the intended products and be serialized.

--We should change the product mix of toys and accelerate the development of plastic toys. We should actively develop electronic toys.

--As for plastic products, priority should be given to plastic sheets for agricultural use, packaging materials, building materials, and structural plastics. Active efforts should also be made to develop new varieties that are nontoxic, nonflammable, heat resistant and static electricity resistant, and that are used for fill, modification, and reinforcement.

--We must actively develop enzyme detergents, mixed formula detergents, liquid detergents for use in kitchens, industrial detergents, and special surface reactive agents. Cosmetics and household sanitary articles should also be developed.

--The product mix of the paper-making industry must be further readjusted. We should pay attention to the development of coated-paper processing for publication. Newsprint must develop in the direction of light-weight offset printing paper; relief printing paper should develop toward offset printing paper; wrapping paper, in the direction of elastic paper; high-grade decorative paper in the direction of reprocessed coated paper; and paper board should develop in the direction of strong light-weight board . New products should also be developed for the newly emerging industries.

--In the leather industry, we should focus on the use of aniline pigskin for making garments and suitcases. We should also study new softening and finishing technologies.

--In furniture making, we should shift our efforts in the direction of using panels, dismantling for reuse, assembling and multipurpose use.

--In producing ceramics and glassware for daily use, we should introduce aesthetics with our traditional techniques and should make artistic products suitable for practical use.

IV. Raise Equipment Standards

We should make efforts to improve equipment design, manufacturing capacity, and technical standards by adopting advanced, suitable and multilevel technologies and equipment. Mechanization should be the main aspect of technological transformation for enterprises, so as to gradually raise the level of automation in the production process. We must pay particular attention to the application of electronics, biology and the technologies of energy conservation and comprehensive material utilization.

--We should attach great importance on the use of advanced and suitable technologies of the military industry, heavy industry, chemical industry, and the machine-tool and electronic branches, for the production of consumer goods. We should also focus on the shift of advanced technologies from coastal areas to the hinterland. Mechanical and electronic equipment and the spare parts and accessories should be systematically supplied to the consumer goods industry.

--We must greatly strengthen the capacity to design and manufacture models.

--We must develop highly efficient textile equipment that requires short processing, is suitable for China's national conditions, easy to maintain, and energy-saving. The problems of uneven slivers, cloth defects, color grades, weft faults and other problems of appearance and quality must be solved, and we should popularize the use of self-regulators, electronic yarn cleaning devices, cradle-type drawing equipment, etc., and the technologies and equipment of electronic warp protection, warp let-off, and crankshaft positioning. The number of broad-width looms and shuttleless looms, and the equipment for woolen textiles and nonwoven fabrics should be increased. We should enhance accessory equipment for finishing after printing and dyeing to meet the demand of the market for production in small lots, diversified varieties and designs, high-grade goods and quick delivery.

--We should develop high-speed, short-processing, and large-capacity equipment for the spinning of chemical fibers and "differential chemical fibers."

--In importing technologies and equipment, the departments concerned should closely coordinate their efforts in their mastery, application, and further development, and gradually achieve greater self-sufficiency in the equipment and its spare parts.

V. Pay Attention to the Quality and Hygienic Conditions of Consumer Goods

We want not only more, but also better consumer goods. Substandard products should not leave the plants.

--Hygienic laws for food must be enforced. Foodstuffs which are not up to hygienic standards must not be supplied to consumers.

--Food additives which are up to the hygienic standards should be trial manufactured and produced. The use of toxic or harmful materials in food processing is strictly forbidden.

--We should improve food packaging and its hygienic standards and develop nontoxic packaging materials.

--Safety factors and hygienic requirements of toys must be strictly ensured.

--We should establish and perfect national standards. Except for the products of minority nationalities, we must actively adopt international standards or advanced foreign standards.

--We should strengthen modern testing methods. We should establish test centers for the quality of consumer goods and strengthen quality control.

--Trade-mark laws must be strictly enforced. Products bearing the same trademarks must be of the same quality.

VI. The Geographical Distribution of Consumer Goods Enterprises and the Scope of Their Production

The layout of the consumer goods industry should be properly established according to a master plan on the basis of resources, energy, communications and transportation, market demand, technical advantages, and comprehensive benefits. We should take advantage of the regional strengths and the roles of the coastal areas and central cities in developing the production of consumer goods having local characteristics, and support traditional production areas, minority areas, and areas of production for the minority nationalities.

--The production of consumer goods that are frequently updated and produced in small lots and large varieties should be undertaken mainly by the small and medium-sized enterprises.

--The system of large-scale industrialized production should be adopted for durable consumer goods that are produced in large lots or with fairly complex technical equipment, or are suitable for automatic and continuous production. If conditions permit, small and medium-sized enterprises should be expanded and technically transformed, and the scope of their production should be based on the most economical batch process.

--Generally, we should not build any more sugar refineries that process less than 1,000 tons of sugarcane or beetroot each day; nor should we build any new brewery with a daily output below 5,000 tons, any refrigerator or washing machine plant with an annual output below 200,000 sets, any electric fan plant with an annual output below 300,000 sets, any cotton textile mill with less than 25,000 spindles, or any grass pulp paper mill with an annual output below 10,000 and having difficulty with the installation of alkali recovery equipment.

--In the production of glassware for which heavy energy consumption is required, we should build large plants with a daily output of more than 100 tons. We should eliminate bottle and can factories with a daily output of less than 50 tons and high energy consumption.

Section Six

Main Points of Technology Policies for Machinery Industry (Excerpts)

I. Adhere to the Principle of "Quality First"

--We must attach primary importance to the quality of mechanical products and give priority to basic parts in the improvement of quality.

--We must actively adopt international standards, set up and strengthen a complete standard system, and raise standardization, serialization and interchangeability of the machinery industry to a higher level.

--All mechanical products must now strictly conform to existing standards. New products, high quality products, and export products must conform to international standards. Major products should reach international standards.

--We should establish and perfect a system of good quality guarantee. We should practice total quality control, set up quality testing centers for all industries, and equip them with the necessary means of testing. We should strengthen quality feedback and post-sales services to ensure good quality.

--We should set up a permit system in a planned and systematic way for production and exports.

--Systems for quality monitoring and product appraisal should be established.

II. Establish Priorities for the Basic Parts Industry

--We should establish an industry for the manufacture of interchangeable basic parts of dependable quality with advanced technologies as the foundation of machinery development.

--We must break down the departmental and regional barriers in organizing specialization and cooperation and in working out an overall plan for the geographical distribution of basic parts production points. We should avoid overlapping production and blind development.

--Consolidation and inspection should be conducted in enterprises producing basic parts in accordance with regulations concerning the issuance of production permits. Those failing to meet the requirements will not be permitted to continue their production.

--We must adopt new technologies, new techniques, new materials and new equipment to tackle the difficult problems of basic parts and continue to improve their quality and to speed up their renovation.

--The plants which manufacture main engines will have priority in the choice of basic parts. Key parts may be imported, if necessary.

--The plants which manufacture main engines should attach great importance to the improvement and renovation of the basic parts that they themselves specially produce. They must constantly improve the performance, reliability and service life of these basic parts.

III. Greatly Strengthen Basic Technologies

--Research should focus on the application of the theories on mechanical strength, structure, vibration, noise, corrosion, wear and tear and lubrication, information, control, system, thermoengineering, fluid mechanics, insulation, dependability, and other techniques.

--We should adopt theories and methods of modern design. We should popularize the application of optimal design, modular design, dependability design, model design, system design, and value engineering with the active aid of computers.

--We should attach great importance to the collection, testing and accumulation of data. The standards of designing, the program library, and data bases will be set up in a planned way.

--We should improve the materials structure. To develop the structure of splice welding, we should increase the proportions of pipes, plates, shaped steel materials, alloy steel, low alloy steel, cast iron, materials for powder smelting, engineering plastics, compound materials, and other high-performance materials.

--We must correctly select and properly use the materials, fully tap their potential, and make better use of them.

--We must vigorously develop new techniques for the manufacture of machinery. We must selectively develop technology that requires little or no cutting, the technologies of batch processing, precision or superprecision processing, large-item processing, special and strengthening-toughening processing, and coating and assembling technologies.

--We should develop various testing and measuring technologies, raise the level of testing, and selectively develop the technologies of quick and enhanced simulation experiments, precision measurements, non-destructive testing, effect-loss analysis, as well as technologies for testing the functions of entire machines.

IV. Raise the Technical Standards of Basic Machinery

--We should make great efforts to develop processing equipment that saves energy and is highly efficient, and that causes no environmental pollution. We should pay special attention to high precision and high efficiency casting equipment, forging machinery, automatic welders, and vacuum heat treatment equipment with controlled atmosphere.

--We should adopt advanced technologies for machine tools, improve their precision, and precision-keeping properties. We should focus efforts on the development of digital-control machine tools and heavy machine tools of high precision and high efficiency and the related cutters, emery wheels and extra-hard tools. If technically and economically justified, we should selectively and appropriately develop and adopt industrial robot and other flexible technologies. We should actively adopt digital display equipment and simple digital control equipment, while transforming the ordinary machinery we now have.

--We must exploit the new technologies of modeling, and raise the standards of designing, manufacturing, and application.

V. Accelerate the Development of Instruments and Meters

--We must energetically develop the application of micromachines, microprocessing, and integrated circuits in instruments and meters, develop new types of instruments and meters, and increase their capability, precision, and dependability.

--We should enhance our study and production of materials, techniques, special circuits, and new sensing elements for instruments and meters.

--We should actively develop technologies in the systems of automatic testing, control, and management.

--We should develop various types of new equipment for image display and for information transmission, classification, and retrieval.

VI. Actively Adopt Electronic Technology To Raise the Level of Automation

--We must actively develop integrated mechanical-electronic systems, produce mechanical-electronic products, and raise standards of performance and automation of mechanical products.

--We should combine automatic with semiautomatic, and mechanized with semi-mechanized production in the machinery industry. We should determine the choice of automation projects and the level of automation according to their overall efficiency.

--The use of computers in designing, manufacturing, testing, and management should be accelerated and industrial control machines and computers peripherals should be developed.

VII. Priority for Development of Energy-saving Machines

--For primary energy conversion and transmission machinery their energy consumption and efficiency indices must be included in their specifications.

--We must study and popularize advanced energy conservation technologies. New energy-saving products must be developed quickly to replace machines having high energy consumption, especially industrial boilers, thermal power plant equipment, industrial kilns, small and medium-sized transformers, AC motors, electric welders, pumps, refrigeration equipment, compressors, blowers, air separators, locomotives, ships, motor vehicles, tractors, diesel engines, and so forth.

--We must improve the utilization of residual heat, the combined production of heat and power, hydraulic transmission, and the trial manufacture and production of new energy machinery and equipment; and develop the use of energy-saving technologies and means of measuring, monitoring, regulating, and controlling energy.

VIII. Develop Complete Sets of Technologies and Heavy Equipment

--We must develop complete sets of equipment for the state's key projects, and increase our capacity to manufacture them in China.

--We must develop the technologies of producing complete sets of equipment, optimize their system function, and enhance system dependability.

--While developing complete sets of single engines, we must also produce more complete sets both individually and in systems.

--For large turnkey projects, we must implement the policy of "treating scientific research, design, experiments, manufacture, installation, application, and maintenance as an integral system," and designate general managers and chief engineers to undertake their trial manufacture. Departments manufacturing and using them should cooperate closely.

--We should develop contracting businesses and consulting services across trade barriers for turnkey projects and improve the capability of their organization and selection.

IX. Accelerate the Development of Specialized Production and Cooperation

--On the basis of standardization, serialization, and interchangeability, and provided that the structures of the products and the techniques used in their production are similar and economically rational, we should systematically readjust and transform existing plants in order to set up and perfect a cooperative system for the production of specialized products and specialized spare parts with specialized techniques in the machinery industry.

--The state should support and encourage specialized production and cooperation in the way of investment, technological transformation, technology imports, credit, pricing, tax rates, and the allocation of energy and materials.

--We must remove the departmental and regional barriers, and use economic and administrative means to prevent existing plants from blindly expanding into all-inclusive plants, and to prevent, even more strictly, the construction of new all-inclusive plants.

--Specialized plants must improve their management and the quality of their products, lower their production costs, and guarantee the delivery of goods according to contracts.

X. Greatly Strengthen Research and Development, Popularize Achievements of Scientific Research

--We must greatly strengthen the enterprises' work of research and development, and their capability to master and apply new technologies and new techniques and to develop new products.

--We must give full play to the roles of comprehensive research institutes, product research institutes, polytechnic research institutes, institutes affiliated to factories, the Chinese Academy of Sciences, universities, and vocational colleges, and local research institutes. They should be combined to form a system for the study and development of an open machinery industry in which each of them should contribute its own specialty in catering to one another's needs and in promoting scientific research and production.

--We should select research units with good potential and solid foundation to serve as technical development centers for different industries.

--We should verify the percentage of scientific research achievements which have been widely used and of the newly trial manufactured products which have been put into regular production.

--We should greatly encourage information exchange and promptly adopt a computer-aided system of searching for information on the machinery industry.

XI. Actively Import Suitable Advanced Technologies, Increase Self-reliance

--In the development of technology in the machinery industry, we must adhere to the principle of combining research and development at home with importing suitable advanced technologies from abroad. The items to be imported must be determined according to the necessity of their application in production and our capability of assimilating and developing them. At the same time, we must consider China's systems of standardization and measurement. We must avoid unnecessary and duplicate imports.

--We should give priority to designing and manufacturing technology, while minimizing the amount of mechanical equipment that we import. We should adopt the system of combining technology with foreign trade and combining the department manufacturing with the department using the machines.

--We must do a really good job in the mastery and application of imported technologies and follow the principle of learning, using, transforming and further developing, in order to turn them into Chinese technologies and to popularize them as soon as possible.

XII. Accelerate Technological Transformation in the Machinery Industry

--The technological transformation of the machine-tool industry must be one step ahead of others. We must make full use of the scientific research achievements already made in China and the advanced technologies imported from abroad in improving the properties and quality of the products, in raising the standards of manufacturing techniques and business management, and in enhancing the enterprises' resourcefulness with greater economic benefits as the end result.

--In technological transformation, we must make full use of the enterprises' existing facilities, carefully conduct technical and economic analyses, and prevent the building of large and all-inclusive plants and the rash expansion or building of plants.

XIII. Step Up Research in Management Science, Continue To Raise Management Standards

--We must study and review experiences at home and abroad in machinery industry management, enterprise management, and the management of science and technology, and popularize the suitable methods of modern management. To

strengthen enterprise management, we must first consolidate the system of job responsibility as well as technical discipline, strengthen the basic work of first-hand records, statistics and their verification, and then establish and strengthen the scientific systems of verification indices and verification.

--We must establish and strengthen the structure of research in management science, so that we can conduct the research and apply the science. The subjects of research in management science, like those in other sciences, should be included in the scientific research plans at various levels, and given financial support. We should reward research achievements.

--We should strengthen industrial management in the machinery industry. We must pay great attention to the research in development strategy and in technology policies, and to technical and economic study, in order to provide scientific data for policy decisions as well as macroeconomic guidance in technical and economic activities in the machinery industry.

Section Seven

Main Points of Certain Technology Policies on Materials Industry (Excerpts)

I. Strengthen Geological Prospecting and Mine Construction

Geological prospecting and mine construction provide the foundation of the materials industry, and must therefore be strengthened.

--There should be an overall analysis of the situation of resources, as well as an appraisal of the economic benefits, environmental benefits, and social benefits from mines. We should conduct comprehensive basic geological work in key mining areas, and develop the new technologies of physical-chemical prospecting, artificial diamond drills, remote sensing, and mathematical geology.

We should strengthen geological prospecting work and focus on high-grade mineral resources with good comprehensive results and that are ready for exploitation in the near future.

--We should give priority to those mines which have easily extracted and selected ores, require little investment, and show quick results. Overall plans should be worked out for large mines to be built in different stages, and for them to be comprehensively developed and intensively exploited. We should also develop small local collective mines, provide active guidance in scientific management and technology, and use the resources properly.

--Both extraction and tunneling (stripping) should be carried out, with tunneling (stripping) taking the lead, and both rich and poor mines should have regular and rational operations. Indiscriminate mining and tunneling are strictly forbidden.

--We should have as many open-cut mines as possible, strengthen their extraction capacity and use the techniques of stage-by-stage mining and steep side mining.

--For underground mines, we must use high-efficiency, low-cost methods and make every effort to reduce the rate of losses and to lower the dilution rate.

--We must develop ore selection and waste disposal technologies, raise the grades of the selected ores, step up the cracking and screening techniques, reduce the granularity of ore to be crushed, increase the efficiency of grading crushed ore, and pay attention to the dewatering of the products or tailings.

We must develop ore dressing chemicals that have low toxicity, high efficiency, low cost, and an extensive raw material source.

II. Comprehensive Utilization of Resources

--We must make full use of China's abundant ferrous and nonferrous mineral resources.

--Joint production mines must rely primarily on one or two exploitable minerals. We must determine their marginal grades, and comprehensively appraise, develop and properly utilize all useful components.

--Comprehensive utilization of key mines' resources, and the recovery and use of precious metals, rare metals, and sulphur elements must receive careful attention.

III. Conservative Use of Materials, Careful Recovery and Utilization of Discarded Materials

--Production departments must raise the proportion of useful materials and prolong their service life, while the departments using them must raise the utilization rate by practicing economy.

--Discarded materials to be recovered and used are secondary resources. We must set up a complete system of recovering, processing, and utilizing them. All materials should be classified for processing.

We must strengthen the development of recovery techniques and equipment for discarded materials.

IV. Carefully Develop, Popularize Advanced Technologies

--In the iron and steel industry, we should give priority to the development of continuous casting technology. We must raise the proportion of continuous casting products and improve model casting and rolling technologies.

We must develop the new technologies of pretreatment of molten iron, top and bottom blowing, refining with super-performance electric furnaces, extra-furnace refining, injection smelting, controlled rolling, controlled cooling, and non-destructive testing in the production line. We must also develop the new technologies of direct reduction and melting reduction in iron smelting.

We should develop the new techniques of iron alloy smelting and the new energy-saving techniques of serial joining with internal heat and the use of graphite.

--While developing the production technology for nonferrous metals, we should also vigorously develop titanium production technology, and adopt technologies for continuous smelting, enriched blast smelting, vacuum smelting, powder smelting and the use of hot static pressure.

We should study and adopt new technologies of extracting gold by the carbon pulp method, the pulp and resin method and the thiourea method.

--We should study the new system of catalysis with organic high molecular materials, improve the techniques and the technologies of monomeric purification, polymerization, and post-treatment. Through modification, we should develop new varieties and improve the quality and properties of the products. We should step up our research in the new technologies of processing and setting plastics, and develop high efficiency, multipurpose additive and modifiers with little or no toxicity.

--We must develop the technologies of tempering glass, shaping by winding, and fiber surface processing; the technology for further strengthening safety glass, the centrifugal arc method for quartz glass, the two-step method of gas smelting, the technology of synthetic crystal ion injection, the technology of crystal calcining, limiting technology and compound technology, and the technology of strengthening and toughening ceramics.

V. Improve Product Mix and Quality To Meet Consumer Needs

--We should improve the product mix of the iron and steel industry by vigorously developing low alloy steel, alloy steel and various types of highly efficient rolled steel. The ratios of steel plates, pipes, and bands should be raised in the output of rolled steel, and we should concentrate on products that are urgently needed in large quantities, products for intensive processing, technology-intensive products, and economical rolled steel. We should increase the varieties of iron alloy and various intermediate alloy products.

We should develop new types of high-quality refractory materials, including those without specified shapes, and improve the quality of coking in metallurgy.

We should also develop permeable coated graphite electrodes and new carbon materials for ultrahigh power graphite electrodes and positive electrode aluminum materials.

--We should carry out intensive processing for nonferrous metals according to market demand, and the product mix should consist of more varieties. With aluminum, we should develop economical plates, bands, foils, and shaped materials; with copper, we should develop bands, thin-walled tubes, shaped materials, and precision alloy materials. Rare metals and semiconducting materials may be suitably made into finished products to meet consumer needs.

--Organic high molecular materials should be selectively used in developing chemical building materials, agricultural plastics, structural plastics, and new types of materials for packing, electric insulation, high molecular coating, bonding, sealing, heat retention and heat insulation.

--We should develop inorganic nonmetallic materials and fiber-reinforced compound materials. Tempered glass products should also be selectively developed.

--We should greatly improve the quality and precision of products. Our objective is to meet advanced international standards and the consumers' requirements, and we should work out the standards for internal product control.

VI. Raise Equipment Standards

--We should combine the trial manufacture of equipment with technical research and improve the facilities for the research and manufacture of special equipment.

--We should use mechanized equipment in mining, and trial manufacture new types of ore selection equipment to raise the level of automatic selection.

--Equipment for the iron and steel industry should develop in size to become suitable for continuous and automatic operation. We should give priority to the development of oxygen converters, while suitably developing electric furnaces. We should make good use of existing open hearths, because they will no longer be built. We will eliminate side-blown converters, whereas we will develop new types of rollers, heat treatment equipment, and finishing and testing equipment.

--In the nonferrous metal industry, we should pay special attention to the production of large high-pressure melting equipment for aluminum, large energy-saving electrolytic tanks, self-heating smelting equipment with enriched blast for heavy metals, wet-method smelting equipment, and the special equipment for titanium, semiconductors, and rare metals.

--The polymerization equipment for organic high molecular materials should be larger in size and automatic. The equipment for post-polymerization processing should develop in the direction of mechanized, continuous, and sealed operations. We will step up the trial manufacture of processing and forming equipment.

--Advanced forming techniques will be adopted in the inorganic nonmetal materials industry, and processing equipment will be mechanized. We should improve the structure of kilns and firing equipment.

VII. Raise the Level of Automation in the Production Process

--We should improve both the auxiliary equipment used for measurement and testing and the control system in each work process. We should gradually introduce computer technology in controlling and managing the production process.

--We should strengthen the training of operators and administrators in the computer and automation technologies.

VIII. Lower Energy Consumption, Use Energy Wisely

--We should adopt new techniques and new equipment for energy conservation in line with the principle of using less but better materials.

Ventilation facilities should be set up within short distances in mines. The work of ore cracking should be strengthened so as to reduce the granularity for the grinders. All kilns should undergo technological transformation with energy conservation as the objective, and mining operations and heat supply systems should be improved.

We should improve the grade of iron in the ores fed into the blast furnaces and mix raw materials more evenly with better granulation in order to improve the structure of the furnace charge. For blast furnaces, we should adopt the technology of using high top pressure, high temperature blast, and an economical fuel ratio, and develop the techniques of continuous casting and rolling, heating the liquid core of steel ingots and preheating for coking, and new coke quenching methods. We must properly control the output of cast iron, and use more discarded materials for smelting so as to lower the ratio of iron and steel to be used. We should transform high energy-consumption equipment.

For the smelting of copper, lead, zinc, nickel and sulfide minerals, we must make full use of the sulphur in the ores as fuel, and adopt the technologies of enriched blasts and self-heating in smelting. The new technologies of indirect heating, high-power melting and fluidized-bed baking should be used in producing oxidized aluminum. For aluminum electrolysis, we should use the technology of large pre-baked electrolytical tanks; and for the processing of aluminum, copper and zinc, we should adopt continuous casting and continuous rolling technology as much as possible.

For the organic high molecule materials industry, we should have optimal operating parameters, strengthen the utilization of reactive heat, develop high-efficiency precision separation technology, adopt the highly efficient tray basin fillers and properly maintain insulation for the equipment and pipelines in order to reduce energy loss.

--We should properly use residual heat from kilns and their slag and products as well as combustible gas.

--We should readjust enterprise structure to ensure the continuity of production and to reduce energy loss. We should gradually eliminate the use of cupola furnaces for steel smelting and the practice of repeated cogging, and reduce repeated firing in smelting. Nonferrous metal smelting plants should increase the varieties of cast ingots and directly produce large slab ingots, round ingots, blank strips and pressure-cast blanks.

--The enterprises producing aluminum, bismuth, titanium, iron alloy, carbon, calcium carbide, and caustic soda should be built close to the areas where electric power resources are abundant.

We should vigorously develop energy-saving materials, such as hydrogen-accumulating materials, light structural materials, and heat preservation and insulation materials.

IX. Vigorously Develop New Materials

--In developing new materials, we should pay special attention to high-temperature structural ceramics, functional ceramics, high-strength steel, new alloys, noncrystal materials, compound materials, optical fiber materials, functional crystals, new high molecule materials, organic separating films, chemical propellants, damped oscillation materials, electronic information materials, superconducting materials, and other new energy materials.

--We should work hard to popularize the transfer of military products for civilian use, stabilize batch production, guarantee good quality and lower production costs.

X. Strengthen Research in Applied Technology of Materials, Select and Use Materials Properly

--We should strengthen research in the properties of materials as required by the manufacturing techniques.

--Research should be conducted in the technologies of strengthening and protecting materials.

--We should step up research in applied technologies of materials, especially in the use of new types of steel, rare metals and other new materials. The materials must be properly selected. We should fully tap the potential of materials.

--We should step up our research in the strength, fatigue, wear and tear, aging and corrosion of materials, improve their properties, and raise their application level.

XI. Pay Special Attention to Environmental Protection, Promote Safety in Production

--We should evaluate the safety factor, hygienic conditions, and effects on the environment of technologies. We should adopt new techniques and new equipment causing little or no pollution, and take active measures to upturn soil for farming and tree planting.

--In work posts exposed to toxic dust, especially in mines, prevention should be strengthened against silicon dust, gas, and exhaust gas hazards. We must improve the techniques to reduce silicon dust, to promote ventilation, gas exhaust, and air purification in addition to other safety measures. Work conditions must be improved.

--Great efforts should be made in the conservation and use of water.

--We must vigorously develop treatment and the comprehensive utilization of the "three wastes."

--Industries engaged in organic chemical materials should adopt the sealed circulation process and eliminate as much as possible the "three wastes" in the process.

Section Eight

Main Points of Technological Policies on Construction Materials Industry (Excerpts)

I. Rationally Develop Raw Material Resources, Actively Carry Out Comprehensive Utilization, Fully Utilize Industrial Waste

--We should raise the utilization rate of cement resources, and develop deep extraction for limestone mines. We should adopt prehomogeneity technology in the utilization of low-grade raw materials. Develop shale and industrial waste residue burden, and minimize the use of clay so as not to destroy farmland. We should actively develop additive materials for cement.

--We should protect silicon sand resources for making fine-quality glass. Silicon sand materials should be gradually standardized and commercialized.

--We should properly use ceramic raw materials. We should actively utilize gangue, low quality materials, and industrial slag, and develop emulsified glaze or color glaze.

--We should liberally use industrial slag such as fine coal ash and gangue. We should also properly develop and utilize natural resources and prohibit any destruction of farmland.

--We should strengthen management over the quarrying of sand and stone and the production of lime.

II. Greatly Lower Energy Consumption, Use Energy Rationally

--We should develop new dry methods of cement processing, especially with the use of extra-kiln decomposition. Under normal conditions, we should not expand or build any wet-processing kilns. Existing wet-processing kilns must be treated differently and transformed systematically. The small cement plants should use mechanized shaft kilns which will gradually replace ordinary shaft kilns. The small rotary kilns in which the hollow drying method is used should undergo technological transformation.

--In the cement industry, we should use coal for fuel (except for a few special types of cement). Rotary kilns should use high-calorie bituminous coal.

--We should make efforts directed mainly at the development of modern technologies centering on the flotation process in plate glass production. Some other technologies may also be adopted according to local conditions.

Existing enterprises should undergo technological transformation with energy conservation and quality improvement as their main concern. We should gradually eliminate small glass plants which are in no condition to be transformed.

--Kilns producing plate glass should use high-heat fuel (such as heavy oil and natural gas). Glass plants with an output below 300 tons may also use generator gas, and small kilns with an output of less than 500,000 boxes should not burn any oil (except in the production of special products).

--The ceramic bathroom fixture industry should develop the new low-temperature quick-firing technology without the use of refractory containers for raw materials. We must popularize muffled kilns, roller kilns, tunnel kilns and other advanced kilns with low energy consumption.

--We should accelerate the development of hollow sintered clay products and gradually reduce the ratio of solid bricks. Circular and tunnel kilns should be popularized, while the small indigenous kilns with high energy consumption should be gradually phased out. The use of low-heat fuel for brick making should also be popularized.

--We should adopt auxiliary refractory materials of good quality. We should improve the structure of kilns and the fuel technology, and make full use of residual heat. We should use heat retaining and insulation materials extensively, and implement reasonable heat retention for kilns.

III. Readjust Enterprise Structure, Accelerate the Development of Large and Medium-sized Key Enterprises, Actively Transform Small Enterprises

--We should quickly increase the number of large and medium-sized construction materials enterprises and improve the technology and economic results of the construction materials industry. In building and expanding large and medium-sized cement plants, we should use extra-kiln decomposition equipment

for a daily cement clinker output of 2,000 tons and 4,000 tons respectively, or most probably 2,000 tons in the near future.

For new and expanded production lines of glass using the flotation process, the equipment should be capable of producing 300, 400-500, and 700-800 tons daily, or most probably 400-500 tons in the near future.

The annual production capacity of new and expanded ceramic bathroom fixture factories should not be less than 1 million square meters of facing tiles or 150,000 pieces of bathroom ceramics.

--Active efforts should be made to transform small construction materials enterprises.

We should transform small cement plants mainly by equipping them with mechanized shaft kilns for an annual capacity of 50,000 and 100,000 tons together with the supplementary technology.

Small cement plants with favorable conditions may be expanded and upgraded, by adopting the technology and equipment of extra-kiln decomposition for a daily output of 700 tons of chamotte, or, pre-heated kilns may be expanded and upgraded to achieve this purpose.

Small plate glass factories having the required qualifications should be upgraded and transformed, or be equipped to produce other special types of glass according to market demand, while the unqualified factories should gradually be eliminated. We must strictly limit the construction of new small glass factories using less than four machines or the small-scale horizontal drawing method.

All qualified small ceramic factories may be upgraded and transformed. The unqualified ones, which produce poor-quality products with high energy consumption, should be gradually eliminated.

--Large and medium-sized construction material enterprises and raw material bases may be built in places with good resources and fairly plentiful industrial slags.

IV. Improve the Product Mix, Exploit New Varieties, Develop New Materials for Housing Construction

--We should develop special types of cement, such as quick-hardening cement, high-strength cement, low-temperature cement and expanding cement and raise the percentage of high-grade cement. With the use of local materials as a prerequisite, we should produce and use masonry cement, but must not permit the use of high-grade cement in low-grade concrete or masonry mortar.

--We should make great efforts to develop bulk cement, concrete additives, commercial concrete and concrete articles. We must actively set up clinker bases, cement grinding facilities, bulk cement transshipment depots and commercial concrete factories.

--We should actively develop construction materials for rural use and supply auxiliary materials of mostly concrete members for rural housing construction.

--We should accelerate the development of concrete pipe, telephone and power line poles, boats, crossties, and other products.

--We must develop new products and the technology for intensive plate glass processing, and produce hollow glass, coated lenses, and toughened glass of large dimension.

--We should increase the designs and varieties of ceramic bathroom fixtures.

The products should be more artistic and of greater practical utility. Auxiliary products should also be developed quickly.

--We should actively develop blocks, aerated concrete, compound slab, concrete slabs, construction gypsum and other new types of wall materials.

--We should develop new types of materials for house siding, waterproof materials, and sealing materials.

--We should develop various types of heat-retaining and insulation materials, and sound-absorbing materials and gradually achieve serialization.

--We should make great efforts to develop decorative and fixture materials, and to accelerate the development of organic high molecular chemical construction materials.

V. Greatly Increase the Capacity To Manufacture Equipment, Actively Use Computer Technology

--The capacity to develop, design, and manufacture equipment should be increased in order to achieve greater self-sufficiency in equipment and be able to supply special modern equipment in complete sets for the construction materials industry.

--We should equip the new plants and upgrade the old ones with advanced, efficient, light-weight, and energy-saving equipment and renovate the equipment of low efficiency and high energy consumption.

--Computer technology should be used in a planned and systematic way for the control and management of the production process.

VI. Improve the Packaging and Shipping of Products

--Packaging for all construction materials should be greatly improved to avoid loss and damage as much as possible.

--We should vigorously develop bulk cement.

--We should develop packaging for containers for plate glass and other fragile articles.

--We should package construction materials for exports more attractively.

--The shipping radius for all construction materials should be carefully determined, and materials obtained locally should be used locally to avoid long-distance hauls.

Section Nine

Main Points of Technology Policies on Urban Construction (Excerpts)

I. Progressively Perfect Rational Urban Systems in Which Cities Will Spur the Development of Surrounding Areas

--On the basis of planned national and regional land use, we should progressively perfect our large, medium, and small cities as organized urban systems, which will have the central role of fully promoting coordinated regional economic and social development.

--City planning departments should participate in the site selection and in the preliminary work on key state capital construction projects.

--We must have a rational set-up for different industries in new cities. We should also carry out readjustments in existing cities in order to achieve a balanced male-female population, to provide more job opportunities, to form a rational social structure, and bring into play the comprehensive function of cities.

--Cities in economically developed regions should properly readjust their production structures. They should systematically shift their industrial, technical, and intellectual resources and organize a rational population flow to underdeveloped regions.

--Open cities should become bases for importing technologies, funds, and skilled personnel, collecting information, absorbing management expertise, expanding foreign trade, and maintaining relations with other parts of the country.

--In economically underdeveloped regions, we must pay attention to the development of central cities in order to promote the development of their surrounding areas.

II. Control the Size of Large Cities, Rationally Develop the Medium-sized Cities, Actively Develop the Small Cities

--We should make scientific population forecasts according to the law of population growth, and should make every effort to keep the planned figures consistent with actual developments.

--There should be a rational division of work according to the conditions in each locality and the regional economy. We should determine the special characteristics of the cities and their development goals in a scientific way. We should carefully determine the production structure and scope of development of famous historical and cultural cities and scenic and sightseeing cities.

--We must control the size of the population in large cities, and especially the population growth in the city proper. Large industrial projects must not be started in the city proper, and projects that occupy large land areas, require heavy water consumption, or cause serious environmental pollution must be strictly controlled. At the same time, some industrial projects should be dispersed in the countryside in an organized and systematic way.

--Satellite towns should be established systematically and selectively. There should be convenient, rapid communications and transportation services between these satellite towns and the cities, and the standard of public utilities in the former should be up to or even above that of the latter.

--We should take full advantage of medium-sized cities. We should give priority for new projects required in building base cities to those medium-sized cities having rich resources, convenient transportation, and adequate infrastructural facilities.

--We should build small cities to absorb the increased urban population. We should selectively develop some cities with favorable conditions as regional centers or medium-sized cities for special purposes.

--We should create conditions to develop the qualified rural market towns into towns, and to develop qualified county cities into cities without delay.

--We encourage the opening of enterprises and establishments in small cities.

III. Unified Planning for Construction Projects in Cities and Their Rational Geographical Distribution

--In choosing a site for city building, we must have ample water resources, convenient transportation, and good natural conditions, and, if at all possible, avoid underground mines, seismic fault zones, and sites with underground cultural relics. We should also be careful in choosing locations with favorable conditions for flood and earthquake prevention and with good engineering geological conditions.

--The planning of city distribution should conform to local conditions, and the demarcation of regions should be rational. Construction projects must be tightly centralized.

--The distribution of cities must be flexible so that room is left for further development.

--Industrial projects, especially large and medium-sized projects, should be arranged in clusters forming industrial zones and districts of different characters and scopes and different working neighborhoods. Industrial projects (especially those causing pollution) must not be situated on the windward side of cities, on the upper reaches of rivers, or in scenic or cultural areas of high value as tourist attractions.

--Residential housing should have priority in the use of land with a good natural environment. Cities along rivers and sea coasts should allot a certain part of the shoreline for use in daily life.

--Freight train trunk lines should not run through any city, and large warehouses or marshaling yards should not split cities into separate parts. We should solve any problem a city may have from their impact.

--We should rationally open and comprehensively utilize underground space. We should make full use of air raid shelters.

--Aesthetics should be stressed in construction. In designing cities, we should take full advantage of the mountains, rivers, lakes and the natural landscape to form a pleasing skyline that adds to the city's beauty.

--We should carefully plan the utilization of suburban land. All houses, roads and pipeline networks should be built according to a unified plan and under efficient management. We should carefully handle relationships between the city proper and its suburbs.

IV. Use Land Properly and Frugally, Guarantee Its Availability

--In accordance with city planning, we should set up a proper procedure of city construction and development, work out scientific short-range construction plans, and systematically expand the use of city land. City planning departments should exercise better control over the land under their jurisdiction and make thorough readjustments if any land is improperly used or left idle.

--City land should be used in combined plots for centralized development.

--We should work out scientific standards as soon as possible for the density of buildings and population, and for the use of land for different purposes.

--In city construction, we should increase the number of stories for houses. There should be more all-purpose buildings.

--Poor land, wasteland, and slopes should be fully used in city construction.

--The availability of land for state construction must be guaranteed. There must be careful calculation in land requisition so that whatever has been requisitioned is fully utilized. For the comprehensive development of an area, land may be requisitioned on a one-time basis and allotted in installments.

V. Gradually Transform Old City Areas

--Old city areas should be carefully preserved, properly utilized, suitably readjusted, and gradually transformed.

--In transforming old city areas, we should give priority to sections where shacks and dangerous buildings are concentrated, city utilities are seriously inadequate, traffic is choked, and environmental pollution is serious; and to overcrowded airfields, railway stations, and docks. We should create conditions for unified planning, comprehensive development, and advance step by step. If conditions permit, whole areas or streets should be transformed at a time. Haphazard demolition or construction should be prohibited.

--The transformation of old cities should go hand in hand with the cities' readjustment of production structure, technological transformation, land utilization, and improvement of transportation and infrastructure.

--We should pay attention to the preservation of cultural and historical relics and scenic spots. We must also be cautious in preserving the scenic beauty of old cities and their original structure.

VI. Comprehensive Development, Unified Construction, Guaranteed Priority for Infrastructure

--In new industrial and mining towns, satellite towns, newly developed areas of cities, and sections of old cities which are undergoing transformation block by block, we must carry out comprehensive development and unified construction according to city planning.

--We should plan and construct municipal engineering projects and underground networks of pipelines according to a unified plan. Work on underground networks should come before the building of roads and houses.

VII. Strengthen the Protection, Utilization, and Management of Water Resources, Increase Treatment Capacity for Water Supply and Polluted Water

--There should be overall planning, proper development, and unified management with the drainage basins as units. We should define areas of water protection, and adopt strict measures to protect the cities' water sources. Excessive use of underground water is strictly prohibited. We must maintain a balance between consumption and replenishment with artificial recharging in order to prevent land subsidence.

--We must carefully select sources of water and ways of transporting it. Water of different grades will be supplied separately so that good water will be put to good use. We must ensure that drinking water is up to the state's hygienic standards.

--We must carefully conserve water. If water is used in manufacturing there should be planned consumption, supply quotas, extra charge for excessive consumption and rewards for conservation. We should increase the use of

recycled water. The key to water conservation in the cities is proper water consumption for agricultural purposes in the suburbs.

--We should further improve the drainage system of cities. The sewage network should be accessible to more people and polluted water should be disposed of properly.

--We should systematically improve water pipes, both surface and underground, and related equipment to reduce possible leakage and dripping.

--We should carefully conduct hydrologic analysis for cities. We must provide and maintain facilities for flood prevention and shore protection.

VIII. Change the Fuel Structure of Cities, Provide Civilians With Priority Use of Good Quality Fuel, Develop Urban Central Heating

--Based on the conditions of resources in each locality, good quality fuel should be first supplied for civilian use. We should make continued efforts to improve the pattern of energy consumption by civilians so that the use of gas and electricity will progressively become common in the cities.

--We should develop fuel gas in cities according to local conditions. We should actively develop coal gas, give priority to the use of natural gas, properly use liquefied gas and energetically recover industrial residual gas.

--We should make great efforts to improve coal consumption and processing technology.

--We should actively develop central heating in cities. We should develop different types of heat sources according to local conditions, and make full use of industrial residual heat.

--Newly built small residential districts should be provided heating from unified sources.

IX. Improve Roads, Transportation and Communications and Public Transportation in Cities

--Based on the overall city planning, road networks and transportation facilities should have an optimal design in order to achieve a rational layout and structure.

--We should increase the traffic capacity of roads. We should widen roads and popularize the use of different roads for different speeds.

--All modes of urban transportation should develop in harmony, with public transportation in the leading position.

--Parking lots should be opened by fully utilizing space on the ground, underground, and in multistoried buildings.

--We should raise the standards of traffic control and set up point, line, and area signal systems and traffic control centers according to local conditions. Traffic signals and signal lines should be installed.

--We should quickly develop posts and telecommunications services and increase the cities' capacity of information transmission.

X. Accelerate the Establishment of Environmental Hygiene Facilities in Cities, Strengthen Environmental Hygiene Management

--We should systematically build and improve trash lanes for buildings, trash collection points, public latrines, septic tanks, trash and manure disposal grounds and other environmental hygiene facilities.

--We will gradually develop a system of classifying trash for collection in receptacles and mechanized trash transportation.

--For trash disposal in the cities, in the near future we should give priority to the technologies of sanitary burying and high-temperature composting. Hospital wastes should be specially collected and disposed of in incinerators.

--We should perfect statutes on the management of environmental hygiene and improve recovery of discarded materials.

XI. Develop Tree Planting in Cities, Build City Parks

--Urban tree planting should be systematically planned and rationally dispersed as required for preserving the ecological balance, improving the environment, beautifying cities, facilitating the people's relaxation and recreation, and many other purposes.

--We must make every effort to increase green areas, and to prevent them from being diverted to other uses.

--The state, the collective and the individuals should take the initiative to accelerate tree planting, so that the cities' denuded ground surface will be gradually eliminated.

--We should carefully handle plans for growing trees in parks and for nursing seedlings to ensure the self-sufficiency of the nurseries in seedlings and saplings.

--China's fine gardening traditions should be inherited and developed. We should also absorb advanced gardening techniques from abroad and develop city parks with tree-decorated landscapes as their main features.

--We must carefully preserve classic parks with historical, cultural and artistic values.

XII. Preserve the Scenery, Strengthen the Planning, Construction and Management of Scenic Spots

--Planning for the preservation and construction of scenic areas must be accelerated under more efficient management.

--We must protect the natural environment of scenic areas and actively restore their natural vegetation cover.

--All activities inside scenic areas must proceed according to plan, and large construction or other projects which may pollute or jeopardize the scenery are not permitted in these areas. No guesthouse, hotel or sanatorium can be allowed to encroach on sightseeing areas.

XIII. Coordinate City Planning With Environmental Protection Planning, Take Comprehensive Precautions Against Pollution To Enhance the Environment

--We should set specific goals related to the environment at different stages according to the cities' characteristics, and share the control of environmental quality between different areas.

--The geographic distribution of industry should be readjusted to reduce sources of pollution. Enterprises located on the windward side of cities or the upper reaches of rivers and causing serious and uncontrollable pollution must be ordered to close down, suspend operations, merged with other enterprises, switched to other lines of business, or relocated within a certain time limit. Enterprises which disturb the people and cause pollution cannot be located in residential areas.

--We must popularize the technologies of controlling the volume of discharge from the source of pollution and of comprehensive prevention, and reduce the pollution load by stages.

--We must study and set up a city environment information system.

Section Ten

Main Points of Technology Policies on Village Construction (Excerpts)

I. Develop a Multilevel Village System With Market Towns as the Core

Rural residential concentrations are divided into market towns, central villages, and basic-level villages. A village system consists of a number of central villages and basic-level villages in an organic entity with a market town as the core. Thus urban and rural areas will support each other and develop in a coordinated fashion.

--Market towns are the production bases for rural enterprises, the collection and distribution points for commercial trading, service centers for the peasants' material and cultural lives, the cores of rural districts, and the link between urban and rural areas. Therefore, market towns should enjoy priority in village construction.

--Villages with fairly large populations and the basic facilities to meet daily needs are called central villages. Basic-level villages are areas in which peasants live in a compact community to engage in the production of agricultural commodities. These villages are of different types, namely, farming villages, fishing villages, or herdsmen's residential areas, according to the nature of the work they are engaged in.

II. Work Out Comprehensive Plans for the Countryside and Plans for Villages, Carry Out Village Construction in a Planned Way

--Village construction must be carried out according to an overall plan, and unified arrangements should be made for the coordination of production, circulation, and various production projects.

--Village plans should include overall plans and construction plans.

The area of application covered by an overall plan is the township's administrative district. Guided by the county city plan and the overall plans for the demarcation of agricultural districts and land utilization at the county level, and based on the development plan and the need to improve living standards, it readjusts and determines the layout, character, size, directions of development, and mutual relationships of the villages.

Based on the overall plan, the construction plan determines the proper layout for each market town or village and includes all-round arrangements for the construction projects to be carried out in the near future.

--The substance and structure of plans for different market towns should be determined according to local conditions. The plans for villages on city outskirts should be coordinated with the overall city plan.

--Different standards should be set for facilities in market towns, central villages, and basic-level villages according to their economic effects, scope of service, and economic capability.

--We must pay attention to both short- and long-range projects in working out village plans.

--In village construction, we must value farmland and use it wisely. We should properly readjust land use in the village so that it can be fully utilized. If the land of the village has to be expanded, we must make every effort to use little or no farmland. We must strictly control the use of land for construction purposes. For residential housing, the land use must be governed by two indices, namely, the foundation area of each house and the average floorspace per person.

III. Combine Alteration With Building, and Place Greater Emphasis on the Former, Gradually Build New Socialist Villages

--With the original village as the basis, we should readjust the layout of residential housing, public buildings, roads, public utilities, and tree

planting so that all the facilities can be centralized and rationally located. In building or expanding villages, we should encourage comprehensive development and unified construction.

--The old structures and public engineering facilities should be properly utilized. They can be gradually renovated to meet practical needs according to our capability. Blind construction requiring extensive demolition and mass relocation should be avoided.

--For villages in which valuable cultural relics, ancient structures, historic revolutionary sites, homes of famous people, or famous ancient trees are located, we should take appropriate protective measures according to the circumstances to preserve their original image.

--We should pay attention to the protection of the natural environment with which all construction projects must be closely coordinated.

IV. Provide Suitable Buildings and Facilities for Economic and Social Developments and People's Daily Needs in the Countryside

--The construction of houses and their attachments should be compatible with the peasants' household undertakings, sideline production, and daily living. Housing accommodation should be distinctly separated and independently used by separate households. Houses should be adequately equipped for comfort and convenience.

--We should provide public buildings and welfare facilities at all levels. Market towns should be provided with complete cultural, educational, public health, commercial, service, sports, scientific and technological, and transportation and telecommunications facilities.

--Buildings and facilities used in production should develop in the direction of high efficiency, multiple utilities, and adaptability, and should have priority in the supply of electricity, water, and transportation and telecommunications facilities.

If houses and facilities used by specialized households for production take up excessive land and may cause pollution that jeopardizes public safety, they will not be permitted in residential areas. They must set up their business in areas intended for production and take precautionary as well as preventive measures.

--Buildings and other facilities for agriculture-foreign trade markets, wholesale markets for agricultural sideline products, special trading markets and warehouses should be located in sections where transportation is convenient. However, their development must not be too close to docks or along the sides of highways.

--We should give priority to the improvement of the water supply system. In market towns and central villages, we should popularize simple tap water supply, mostly centralized [in the form of public spigots]. We should make

active efforts to develop efficient and simple water purification technology on a small scale.

--We should develop facilities for highway and waterway transportation. They should be coordinated with road development in the villages to form a convenient village radial road network.

--Market towns should have highways, roads and streets in a three-level structure, while central villages and basic-level villages should have roads and streets in a two-level structure. Materials for road surfacing should be obtained locally. Main trunk roads and trunk roads should have adequate street lighting and drainage facilities, and be lined with trees on both sides.

--Suitable drainage systems should be set up in market towns and larger central villages. In localities where conditions permit, we should adopt the system of underground drainage which should be coordinated with the farmland irrigation system. In the smaller villages, we can dig drainage ditches which would, according to the topography, empty into irrigation channels or rivers.

--We should set up facilities for environmental hygiene in the market towns. Household trash should be centrally collected and disposed of, public latrines should be improved, while trash and manure should be treated in an effective way to increase sources of fertilizer.

--We should develop the posts and telecommunications system in the countryside in order to transform and improve the village communications network. Each village should have an appropriate number of telephone sets and easy access to the broadcasting and television networks.

--We should develop firewood forests, marsh gas facilities, small coal pits and small hydropower stations and produce more solar energy, wind energy and geothermal energy. These types of energy will complement one another in comprehensive utilization with stress on economic results. We should also energetically develop marsh gas tanks and firewood-saving and coal-saving stoves for households.

--We should take strong measures in environmental protection. Enterprises should treat the industrial "three-wastes" causing pollution until they are up to required discharge standards. Industries which cause serious pollution and warehouses storing dangerous goods cannot be located in villages. The transfer of any industry handling untreated toxic or harmful substances which can cause serious pollution to rural enterprises is prohibited if these enterprises are incapable of protecting against the pollution. At the same time, we must take precautionary measures against pollution harmful to agricultural production and the living environment of herds.

--We must take precautionary measures against wind, floods, tides, fires and earthquakes according to our practical needs and capability.

--We must protect the trees now in the villages, plant trees and grass and gradually increase the vegetation cover.

V. Popularize Appropriate Technologies, Raise Technical Standards of Village Construction

--We must actively adopt all-purpose and standard designs for various local construction projects, develop standardized, finalized, serialized, and industrialized construction components and engineering projects, practice commodity supply, and guarantee the quality of products.

--We should develop all-round service organizations, plan contracting for village construction, and provide designing, engineering, and technical consultation service for rural construction.

--We should organize a specialized contingent for village construction, develop small machines and tools that can serve multiple purposes and are simple and easy to use, and gradually industrialize rural construction.

--Materials should be obtained locally, if conditions permit. We must properly use plant stalks, industrial waste, wild plants, and various natural resources to improve the traditional construction materials and to develop new materials for local construction.

Section Eleven

Main Points of Technology Policies on Urban and Rural Housing (Excerpts)

We should work to provide basically every urban and rural family with economically rational housing so that by the turn of the century, the per capita floorspace throughout the country will be increased to about 8 square meters, and each rural family will have a suitable, hygienic plot to take care of its production and other daily needs.

I. Strictly Control the Building of New Houses and Land Use According to Set Standards

--For urban residential houses, flats and floorspace are mainly used as units of measurement and standards of construction control, while the utility space is mainly used as the standard for allocation control.

--For urban residential houses built with state and collective investment, the national average floorspace for each flat should be strictly limited to 50 square meters in the 1980's. Suitable standards will be worked out for standard fixtures and investment. These standards may be appropriately raised in the 1990's.

--We should build mostly small and medium-sized residential houses in the near future. They should be practical, occupy little land, and be allocated on a one-flat-per-family basis.

--We should make every effort to reduce the construction area, as long as the living space is not reduced and the quality of housing is not affected.

--We must pay great attention to land conservation. Indiscriminate use of farmland must be stopped in rural construction, and a reasonably high density of houses should be maintained in the cities.

--Rural residential houses must be properly distributed. They should be compact, rational, practical, hygienic, safe, and suitable for living and production. We must strictly control residential bases.

II. Raise Design Standards, Ensure a Good Housing Environment

--We should have diversified layouts and models for residential housing in city planning. Through planning and the use of different techniques for individual designs, we should be able to obtain a reasonably high density and a good living environment including the necessary sunlight, ventilation, green patches, and outdoor activity space.

--The design, architectural, and construction jobs for urban and rural residential housing must proceed from the economic conditions in the near future. Convenience for probable alterations in the distant future, when construction standards are raised, should also be taken into account.

--Urban residential houses should be mainly multistoried, but the number of high-rise apartment buildings should be controlled. A suitable number of these buildings may be allowed only in designated areas of large cities.

--New residential houses should be two-storied in villages and two- or three-storied in market towns. We can build more stories if conditions permit. We should develop buildings with comprehensive cultural and service facilities.

III. Practice Comprehensive Development of Housing Areas, Provide Support Facilities

--We should base residential housing construction on the city's overall plan. It must also be carried out under a unified scheme and unified plan for unified development under unified management. There must also be such support facilities as water supply, sewage drainage, electricity supply, gas supply, and heating, and such infrastructural facilities as roads, green areas, public telephones and television antennas in addition to commercial, cultural and educational, public health, sports and administrative facilities. We must adhere to the principle of infrastructure taking the lead and support projects being synchronized.

--For residential houses in the villages, there must be comprehensive planning and support projects, and planning should be carried out ahead of construction. We should strive to develop water purification and water supply facilities, lay drainage pipes and dig ditches, and have extensive tree-planting and road improvement.

IV. Accelerate the Transformation of Existing Houses

--The development of new residential districts must go hand in hand with the transformation of old houses.

--We should set standards for quality grading, while planning to take different measures for preservation, alteration, and demolition on existing houses and residential districts.

--We should improve the infrastructure and environment of old residential districts.

--We should upgrade existing urban and rural residential houses to withstand earthquakes, strong winds, and other natural disasters.

--We should improve the conditions of old village houses for ventilation, lighting, moisture prevention, and sanitation.

--We should improve sanitary conditions and the distribution of public latrines in urban and rural areas.

--We should step up technical research and measures to remodel, repair, and preserve old houses.

V. Select a Housing Construction System of Comprehensive Efficiency According to Local Conditions, Raise the Level of Construction Industrialization

--We must select a housing construction system of comprehensive efficiency--a system that closely conforms to local conditions.

For multistoried houses, in addition to brick masonry, we should actively adopt the block masonry system and the "in situ" system. For high-rise apartment buildings, we should use the system of "pouring concrete into panel forms," the complete poured concrete system, and the framework system. For large construction projects of a continuous and stable nature in large and medium-sized cities with favorable conditions, we can adopt the system of large-panel assembly construction.

--We should make active efforts to develop the large-bay structure system for flexible arrangements in floorspace and for comprehensive utilization of basements.

--We should conduct comprehensive technological transformation of brick masonry.

--Construction work should be mechanized or semimechanized. We should have a multilevel technical structure characterized by a combination of improved tools and traditional technologies, and use portable power-driven tools.

--We should use locally available materials in building village houses. While using traditional materials and technologies, we should also vigorously popularize modern architectural technologies.

VI. Develop Specialized, Socialized Production, and Commercialized Supply of Construction Components and Products

--We should make great efforts to develop all-purpose concrete components and products for urban residential houses, to improve their quality, and to ensure the accuracy of specifications. Wall components should become multifunctional with interior and exterior finishing.

--We should make active efforts to develop interchangeable reinforced concrete components for rural houses and public buildings.

--We must actively popularize the use of commodity concrete, typified assembled formboards, and reinforced products.

--We should develop specialized production of high-quality doors and windows, water supply, heating, electrical, and sanitary equipment, kitchen appliances, and furniture. We should update lamps, sanitary appliances, and small hardware. We should promote the substitution of steel or plastic for timber in the manufacture of construction components.

VII. Build More Typical Structures of Greater Varieties

--A well-coordinated system of architectural modules and a series of parameters should be set up as a guide to the general design of a housing construction system.

--We should promote the designing method with typical functional units and interchangeable components as the basic feature, so that the designs will be both typical and diversified and the floorspace can be used to the best advantage.

--In adopting interchangeable designs, provided the standard components remain unchanged, we should strive for flexible and diversified forms of elevation. In building residential districts, we should take advantage of the topography, strengthen the planning and design of the layout and the methods of decorating them with green patches and miniature architectural objects in order to reflect fully the special characteristics of these residential districts and to create a pleasant living environment.

--We should formulate the policies of choosing the dimensions and shapes of architectural objects, the methods of contact, and a series of tolerance and coordination standards to promote the interchangeability of construction components.

--We should set standards for the properties of various architectural objects.

--We should accelerate the compilation of a general design for rural housing and components.

VIII. Reduce Energy Consumption in Housing Construction

--We should set standards for heat insulation and preservation for the houses, and carefully work out an energy conservation design.

--We should improve the heat retention and insulation properties of walls, doors and windows. We should use wall materials with good heat-insulation properties or compound walls, select a rational window-wall ratio, improve the designs of doors and windows, and increase their airtight capability. In cold regions, double glass panes should be used for the windows of urban houses.

--We should improve heating, electrical illumination, motor power, water supply and drainage, and sanitation systems, and adopt energy and water conservation equipment.

--We should make active efforts to popularize central heating, and pay attention to the recovery and utilization of waste and residual heat.

--We should develop and utilize solar energy, geothermal energy and methane.

IX. Develop Structural Materials Selectively With Priority on Reinforced Concrete

--We should increase the output of cement, improve its quality, and develop structural materials of reinforced concrete.

--We should focus on the production of sand and stone aggregates and the supply of products according to quality standards.

--We should adopt different technologies and methods in cement conservation. We should use concrete admixtures, fine coal ash, natural gangue and other blunging materials liberally.

--We should popularize and develop prestress and partial prestress technology, properly select the varieties of steel wires and steel ribs, and improve their quality.

--For public buildings, we should appropriately develop light steel structures, lattice structures, and light-weight heat-preserving roofs.

X. Improve and Develop Wall Materials and Other Accessory Materials

--Brick-making projects that destroy fields are prohibited, but operations that create farmland are advocated. We must find different ways to increase the sources of materials for brick-making.

--We should strive to improve clay brick. We should give priority to the development of load-bearing porous brick, nonload-bearing brick that is more than 45 percent hollow, and coated clay brick.

--We should fully utilize industrial wastes, and make proper use of lava and other natural resources. We should increase the production of mortar products, and gypsum block and board.

--We should make active efforts to develop common concrete, various types of light aggregate concrete, and small hollow block. They should be serialized and developed in the direction of load-bearing, heat retention and insulation, and decorative products of multiple functions and diversified varieties.

--We should strive to develop light partition wall materials.

--We should actively adopt highly efficient moisture preservation materials, waterproof materials, caulking materials, and decorative materials.

--We should strive to adopt various types of plastic products, paints for outer walls and floors, and synthetic timber.

--We should quarry and use stone according to local conditions.

XI. Strengthen the Comprehensive Study and Scientific Forecast of Urban and Rural Housing Construction

--We should enhance our population growth forecasts, changing trends in the family structure, and housing needs. We should complete house surveys, sampling surveys, family income surveys and other basic work.

--We should develop comprehensive research in many different disciplines including housing economics, sociology, and ecology, and then work out and strengthen the related laws.

--We should actively conduct research in land conservation, in building urban and rural houses, in commercializing houses and in setting land prices.

Section Twelve

Main Points of Technology Policies on Environmental Protection (Excerpts)

Economic construction, urban and rural construction, and environmental protection must be planned, developed, and carried out simultaneously in order to achieve a unity of economic, social, and environmental efficiency.

I. Environmental Protection During Regional Development and Construction

--While working out the regional plans and regional environmental plans, we must conduct environmental forecasts and evaluations for economic and social development so that economic development and population growth will be commensurate with the bearing capacity of the environment. In regions with

excessive loads, we should readjust their economic structure and production setup, and control the population size.

--If economically worthwhile, mineral and natural resources should be comprehensively prospected and exploited, and discarded materials should be comprehensively utilized. We should also take precautions against environmental pollution.

--Based on an evaluation of water resources, we should work out plans for the use of water areas and the control of water quality, and conduct comprehensive exploitation and control accordingly.

--We should work out plans for the exploitation and utilization of underground water. As a precaution against water contamination and land subsidence, pollution or excessive use of underground water is strictly forbidden.

--We should properly plan utilization of the coastal sea. For key sea areas, we should establish standards for the total allowable volumes of sewage discharge.

--We should enforce a system of reporting on environmental impact of all construction projects. For large projects of a controversial nature, we should conduct analyses of their economic and environmental benefit or harm .

--Exploitation of mines and oil fields should not take up too much land. We should work out a plan of control in advance for the protection of resources and scenery. We must reuse and improve the land as much as possible according to local conditions.

--In planning the exploitation of forests, pastures, and swamps, we should adopt the system of reporting on the environmental effects and recommend technical measures for their continued utilization and management. Reckless land reclamation, overgrazing, and indiscriminate felling of trees are prohibited.

--We must carefully protect famous historical sites, scenic and sightseeing spots, and nature preserves.

II. Prevention of Environmental Pollution From Industrial and Communications Enterprises

We must transform backward production processes and equipment, raise the standard of enterprise management, study and popularize comprehensive resource utilization technology and use the technical process of closed cycles to turn discarded materials into resources or to render them harmless.

1. Prevention of Atmosphere Pollution

--We must study and develop the technology of separating and selecting the intergrowth of coal and sulphur, improve the quality of coal, and recover

the sulphur. If more than 6 percent of sulphur is contained in the gangue, we should recover the dressed sulphur ores.

--We should trial manufacture and popularize new boilers for burning formed coal, and improve the structure of industrial kilns and combustion technology.

--We should phase out or discard boilers and industrial kilns that are of high coal consumption and low heat efficiency and can cause serious pollution. We should discontinue their production and not use discarded boilers again for other purposes.

--Enterprises using coal, such as power plants, iron and steel plants, nonferrous metal smelting plants and synthetic ammonia plants, should develop and adopt the technologies and equipment of desulphurization and sulphur recovery, and take precautions against sulphur dioxide pollution.

--We should improve the technology of desulphurization of natural gas and recover sulphur resources.

--The combustible gas emitted in the course of industrial production and mining should not be discharged into the air under normal circumstances. It should be recovered and utilized according to local conditions.

--Industrial and mining enterprises with waste fluoride gas exceeding allowed limits should take precautionary measures and enforce discharge standards within certain time limits.

--We should develop the technology of separating and recovering arsenic from metals. If the arsenic in the waste is not worth recovering, the waste must be rendered harmless.

--For soot elimination, we should develop high efficiency, low energy consumption, and low cost technologies and equipment. They should not take up much land.

--Technologies to eliminate soot during production, storage, and transportation should be developed.

--We should popularize the technology of smoke-free coking to eliminate yellow smoke from coking furnaces, and selectively substitute dry quenching for wet quenching.

--We should develop the double-pressure process for the production of nitric acid and gradually replace the old process in order to eliminate pollution from the nitric acid tail gas (oxidized nitrogen).

--The radioactive gases and particles discharged by nuclear equipment should be purified and controlled within the state's discharge limits.

--Standards should be set for the purification of tail gas, and the volume of harmful gas discharged should be strictly controlled. The use of low-lead and unleaded gasoline should be popularized.

--We should provide equipment for the recovery of light hydrocarbon for oil field development projects.

2. Prevention of Water Pollution

--Enterprises should work out plans for quota water consumption, and these plans should be included in their indices of verification.

--The clean and polluted portions of used water should be kept separate. Industrial waste water should be recovered and recycled for use. Cooling water should be used repeatedly, and the technologies of air cooling and water conservation should be actively popularized.

--Waste water containing heavy metals, active poisons, or substances which cannot be easily degraded by the environment should be treated in the plants or through closed cycle. Excessive discharge for dilution is strictly prohibited.

--We should develop alcohol or other types of surface active agents, and prohibit the production of any detergent that cannot be biologically degraded.

--Waste liquid from sugar refineries and distilleries should be recovered for use or properly treated, and must not be directly discharged into rivers.

--The paper-making industry must raise the recovery and utilization rate of alkali (acid), and actively develop the technique of centralized pulp-making. The small pulp factories with a daily output of less than 30 tons should be upgraded and transformed to reduce the loss of black liquor, and the discharge of waste liquid must be kept within limits.

--The leather-making industry should adopt the new techniques of dehairing hides with enzymes. If alkaline ash is used for dehairing, the alkali sulfide, after being fully utilized, should be recovered. In adopting the method of chrome tanning, the chromic salt must be fully utilized and recovered.

--We should study and popularize the technologies of anaerobic fermentation and comprehensive utilization of highly concentrated organic waste liquid, and develop industrial methane.

--Highly concentrated waste liquid and waste gas which contain sulphur in colloidal fiber production should be treated and recovered.

--The waste liquid from oil field development should be separately reinjected or recycled for use. We should develop the technology and equipment of reinjection.

--We should gradually establish a nationwide service system to clean up oil spills at sea.

--We must purify low radiation sewage from the nuclear installations. We should solidify medium radiation sewage, or the concentrates after treatment. Their discharge for dilution must not be excessive, nor can they be allowed to seep into the soil.

--All mercury-using enterprises should eliminate mercury pollution through technical improvement and equipment renovation. They should also use the new technique of making caustic soda with ion film instead of mercury, and popularize the production of instruments and meters without the use of mercury.

--Acidic sewage from mines and enterprises should be recovered as much as possible or rendered harmless.

--We must actively popularize the technique of electroplating which may cause a low concentration of pollutants, and the technique of cleaning by reverse osmosis, and develop the technologies of recovering the waste water from electroplating and regenerating concentrated liquid.

--Poisonous waste liquid being shipped by boat must not be directly discharged into rivers, lakes, or the coastal sea, and must be centrally treated.

--Poisonous and harmful wastes from the cleaning of railroad tank cars must not be indiscriminately discharged. It must be treated until it is up to discharge standards.

--We should develop pesticides of high efficiency, low toxicity and low residue and that are harmless to human beings and animals.

--Ore dressing facilities must have tailing grounds which must be comprehensively planned and established in different areas for different users. The waste water from ore dressing should be reused after treatment in a closed system, and the excess water should be discharged according to set standards.

--Coal mud from coal-washing plants should be recovered within the plants as much as possible. The water should be treated in a closed system or discharged according to set standards.

3. Prevention of Pollution From Solid Waste

--All solid wastes should be properly treated and comprehensively utilized according to local conditions. They must not be dumped into rivers, seas, lakes or the coastal water areas. We should develop an industry for treating and utilizing solid wastes.

--Gangue of more than 1,200 Kcal/kg, if economically rational, should be used locally in fluidized-bed combustion furnaces as much as possible, while that

of 500-1,200 Kcal/kg should also be utilized as much as possible. The remaining portion, which is of no further use, should be safely piled up, and measures must be taken to prevent self-combustion.

--The unwanted rock of mining operations should be properly piled up, and measures should be taken to make them safe. If they contain any polluting substance, antipollution measures must be taken.

--All industrial wastes must be comprehensively utilized, and their disposal must take up as little space as possible.

--We should pay attention to the use of fine coal ash. Ash that may yield good results through simple processing should be comprehensively used according to the local conditions and the characteristics of the ash.

--Harmful wastes which are poisonous, easily combustible, corrosive, or radioactive must first be comprehensively utilized. If they cannot be utilized, special safety controls will be necessary over their production, collection, storage, transportation, and treatment. They must not be dumped into bodies of water or be mixed with other solid wastes.

We should quickly produce special receptacles and mechanical devices and adopt technologies of burning and solidifying, and for physical, chemical, and biological treatments to render them harmless. We should establish special plants for the disposal of harmful wastes.

--We should upgrade the conversion of solid wastes and the recovery of discarded materials.

--Solid wastes of low and medium radiation should be kept in standard storage containers or buried underground. Highly radioactive wastes or solid transuranian waste, after a certain period of intermediate storage, should be permanently buried deep underground.

--We should strictly enforce a registration and control system for poisonous and harmful chemical products.

4. Active Development of New Antipollution Technologies

--While developing new products, new technologies, new techniques and new materials, we should focus on the environmental pollution they may cause, and on the development of the necessary technologies and equipment of prevention. If any scientific research results have adverse effects on the environment or fail to meet the basic requirements of environmental quality, such result will not be adopted and popularized.

--We must make active efforts to study and develop various techniques and mechanical and electrical products that consume little energy, are highly efficient, and cause little pollution (and little noise).

--We should conduct active research and development on composite technology that is useful for general pollution treatment, and on technical production processes that cause little or no pollution.

III. Environmental Protection in Urban Construction

--We should determine the specific environmental goals at different stages for a city according to its special characteristics and functions.

--Taking into account all the social, economic and natural factors, we should work out the city's overall plan and environmental plan, set up separate functional regions, and practice regional management of environmental quality.

--We should actively study and apply the theories and methods of the urban ecological system, properly organize the economic and social activities of cities, and gradually form a rational ecological urban structure.

We should establish an environment information system after careful research in order to improve the management of environmental quality.

--In altering, expanding, or building any urban structure, we should carefully readjust the proportions of space for industry, warehouses, roads, residential areas, and green areas.

--The structure and layout of industry should be readjusted to reduce sources of pollution. We should work out plans so that plants and enterprises with poor economic results and that are incapable of coping with their serious pollution problems can close down, suspend operations, merge or retool.

--We should strictly uphold the principle of separate functional regions. The plants and warehouses dealing in inflammable, explosive, poisonous and harmful materials which may constitute a hazard in residential areas must move away within a certain time limit.

--We should systematically popularize the technology for controlling the total volume of pollutants discharged and eliminate the pollution load by stages.

--We should strive to popularize "clean plants," "sootless streets," "soot and dust control areas," "mini-ecological areas" and other experiments in comprehensive prevention.

--We should gradually achieve special treatment of the "three wastes" and the processing of discarded materials by enterprises on a community scale.

--We should develop central heating in the cities and restrict the practice of dispersed industrial heating and the building of scattered boiler rooms for home heating.

--We should give priority to urban residents in the supply of clean and good-quality energy. We should also utilize different types of gas energy, and actively develop urban fuel gas. If conditions permit, we should develop the use of electricity for cooking.

--Coal with low sulphur and ash content should be first supplied for civilian use. If the sulphur content is high, we should add desulphuring and sulphur-curing agents. We may also supply such coal to users having desulphuring and sulphur-curing facilities.

--Urban boilers and locomotives of less than 4 tons [sic] should use formed coal instead of coal dust or raw coal.

--To protect city water sources, we should develop the technology of turning the sewage into a resource. For urban sewage treatment, we should coordinate the operation of sewage treatment plants with the system of oxidation ponds and soil treatment.

--We should study and develop the technology of reusing purified sewage. Especially in water-deficient areas, purified city sewage should be treated as a secondary water resource to be used in industry, public utilities, planting trees and grass, and irrigation.

--To treat industrial sewage efficiently and to save investment, we should have a combination of pretreatment in the plants and centralized treatment in the city.

--We should improve the state's standards for noise control, electromagnetic interference and counter-interference. We should study and actively popularize technologies and measures of noise control.

--Large launching pads should have clean air protection zones and forest belts. The technologies and means of shielding, absorbing, and filtering should be adopted to eliminate electromagnetic radiative pollution.

--Green areas should be expanded for the public in cities. There should be a national average of 3 to 5 square meters per person as the first step, and 7 to 11 square meters as the second step.

--In city construction, we should preserve or expand the green areas in group or block forms, increase water surface areas, and build a green shelter belt to improve the small-scale climate of cities and to reduce the effects of urban heat islands.

--Places that can accommodate trash piles in cities should be distributed according to an overall plan and concentrated in different areas. Fences or green shelter belts should be built around them.

--We should study and develop the technologies of mechanized collection, transportation, storage, screening and treatment of urban trash with motorized and seal equipment.

--Hospital trash must be rendered harmless.

IV. Protect the Agricultural and Natural Environments in Townships

--We must take precautions against environmental pollution from rural enterprises. In townships and towns, generally, small enterprises should not engage in making indigenous coke and sulphur, electroplating, paper-making, producing asbestos and dyeing materials, leather-making, and nonferrous metal smelting which can cause serious pollution. Enterprises of this type that are already in existence should undergo consolidation and transformation.

--The enterprises which may cause environmental pollution should not be established in residential areas, water source protection areas, famous historical sites, scenic sightseeing spots, recuperation areas, and nature preserves. Those that have already been established should be closed, suspended, merged or retooled within time limits.

--Mercury, arsenic, radioactive products, biphenyl polychloride benzinidine, and other poisonous or highly poisonous materials must not be produced with indigenous methods.

--We should study and popularize the technologies and equipment suitable for small rural enterprises in pollution treatment.

--Transfer of the tasks of producing poisonous and harmful products, which can cause serious pollution, from urban enterprises to the rural enterprises which are incapable of preventing the pollution, is strictly prohibited.

--We should protect and expand the vegetation cover, strengthen water and soil preservation, and develop firewood forests, timber forests, economic forests, and shelter belts according to local conditions.

--In the grasslands, we should popularize enclosed herding, develop composting and aerial seeding technologies, and preserve and expand the vegetation cover.

--Land reclamation on the mountain slopes is strictly prohibited. In areas with serious soil erosion, we should popularize the technology of combining biological with engineering measures that will generally improve small drainage areas.

--We should develop the technologies of preventing the encroachment of deserts and the flow of mud stones, and expand the forest networks to protect the farmland by providing shelter from wind, fixing the sands, and regulating the climate on a small scale.

--We should lay equal stress on the development and utilization as well as the preservation and improvement of agricultural resources. We should maintain a proper ratio between the input and the output of materials so that the

farmland, forests, grasslands, and bodies of water can be continuously utilized, and an ecological system with a benign cycle can be gradually formed.

--The overall planning and infrastructure of rural residential areas (townships) should be strengthened, and tree-planting in every direction should be developed to improve the environmental hygiene and environmental quality step by step in the countryside.

--We should work out plans for the protection of nature preserves, sightseeing areas, the natural scenery on ground and underground, and rare species on the verge of extinction. These plans must be strictly implemented.

--We should carefully protect rare wildlife which is on the verge of extinction. The development and utilization of resources present in other wild animals must not exceed the minimum amount required for their propagation.

--We should study and develop the technologies of artificial breeding and domestication of various species of wildlife.

V. Raise the Standards of Environmental Protection Equipment

--The antipollution and environmental protection equipment must function in coordination with the main equipment which produces the pollutants. Both sets of equipment must be designed, manufactured, and operated simultaneously.

--We must actively trial manufacture equipment that is urgently needed for pollution prevention, especially new types of boilers and furnaces that can save energy and cause less pollution; complete sets of equipment for treating industrial waste gas, waste water and city sewage; equipment for the safety treatment of heavy poisons and inflammable waste that is difficult for the environment to break down; and equipment for noise insulation, noise elimination, noise absorption, and vibration insulation.

--We should develop the new materials necessary for the treatment of environmental pollution, especially the standard reference materials for environmental analyzing and monitoring; the new and highly efficient ion exchange resin and adsorbents; the new film separation materials; the highly efficient emulsifiers for treating waste liquid which contains oil, auxiliary coagulants, highly efficient and low-toxic inorganic and organic flocculants, and highly efficient water quality stabilizers that are low in poisonous substances and safe to use.

--We should develop environment monitoring, analyzing and testing devices, and particularly portable monitors; complete sets of instruments and meters for continuous and automatic sampling, and automatic analysis and one-time atmosphere observation and automatic monitoring systems; automatic water sampling technology, and automatic monitoring instruments for the degree of acidity, electricity conduction, and oxygen dissolution; automatic noise monitors; large-capacity atmosphere sampling devices, and instruments for monitoring and controlling sources of pollution.

9411/6091
CSO: 4008/7

CHAPTER 3. RESPECTING TALENTED PEOPLE

[Text] In terms of acknowledging talent and giving serious attention to the role of intellectuals, the CPC has made outstanding achievements. The founding and growth of the party have always been inseparable from revolutionary intellectuals. However, beginning in the late 1950's, the party gradually deviated from the correct orientation in its approach to knowledge and intellectuals, and made serious "leftist" mistakes. During the "Great Cultural Revolution," the tendency developed to an absolutely preposterous extent and became a major part of the tragic 10-year disaster.

After the downfall of the "gang of four," Comrade Deng Xiaoping and the CPC Central Committee attached great importance to the matter of intellectuals, devoted a tremendous effort to bringing order out of chaos, repudiated the "two basic assessments" ("the educational front in the 17 years prior to the Great Cultural Revolution was the dictatorship of the bourgeoisie over the proletariat" and "a sinister dictatorship"; "the world philosophy of most intellectuals is basically bourgeois is nature, and they are bourgeois intellectuals") and affirmed that China's intellectuals are a part of the working class and that, the same as manual laborers, they, except for the different division of labor, are laborers of the socialist society. Thus, the Central Committee unequivocally declared that the policy of "unite, educate and reform" was totally inapplicable to today's intellectuals, and proposed that intellectuals receive full trust in politics, free employment in work, and warm concern in living. In the past few years, party organizations and the government at all levels have vigorously implemented the party's intellectuals policy. In scientific and technologies communities, they have redressed large numbers of unjust, false and wrong cases, reinstated the technical title evaluation system, and rectified the situation of failing to use people in the fields of their specializations. They have given full play to the professional skills of scientists and technicians, improved their working and living conditions, and recruited unemployed professionals in society. In 1981 and 1982, in line with the instructions of the Central Committee, a nationwide overall inspection of the implementation of the party's intellectuals policy was made. The Central Committee's series of correct policies and effective measures have created a healthy habit of respecting knowledge and talent in China's society.

China's scientific and technological ranks underwent severe tests, remained steadfast in their faith in socialism in spite of Lin Biao's and the "gang

of four's" persecution and devastation and, under extremely difficult conditions, persevered in research work. After the downfall of the "gang of four," their long-suppressed enthusiasm burst forth all at once and, in the attitude of masters of the state, they plunged into the socialist modernization program and made important contributions to the basic improvement of China's economy and the progress of science and technology.

Today, science and technology have become a decisive factor in the development of modern productive forces. The achievement of the four modernizations hinges on the modernization of science and technology. For this reason, properly performing intellectual work in this new historical period takes on an even greater significance. This point is gaining a growing understanding in society and receiving ever greater attention from all quarters. Thus, it has aroused a higher sense of social responsibility in the scientific and technology community. Closely linked with modern production, the vast number of scientists and technicians can understand best its stringent, scientific and highly organizational nature and future development. After introducing the open-door policy, finding themselves in the forward position in welcoming the challenges of the world new technological revolution and confronting the tremendous pace of scientific and technological development and the endless stream of new things, they regret even more keenly the value of time lost and feel the weight of the mission on their shoulders. From their own tortuous experiences, their status in production and construction, and their rich knowledge, they deeply feel that their own destiny is closely linked with the destiny of the state and the nation, and that their own future is fused with the success or failure of reform and modernization. For this very reason, China's scientific and technological communities can be trusted and relied on by the party and the people, and they constitute a backbone force and a valuable contingent in building socialism. Party organizations and the government at all levels must respect, trust and guide them, and assign them jobs commensurate with their abilities. Today, we should pay closer attention to the following aspects.

1. The Study and Improvement of Scientific and Technical Personnel

Scientists and technicians must continuously improve their political-ideological level and professional abilities in order to adapt to the ever changing situation. Study and improvement, in the final analysis, must depend on their own conscious effort. Party organizations have the responsibility to create conditions for them and provide help and guidance, so that they will, on the one hand, fear no difficulty, study assiduously, explore courageously and scale new heights and, on the other hand, be thoroughly realistic, avoid hollow words and give attention to economic and social developments and needs.

The development of modern science and technology changes with each passing day, and the continuing education of scientists and technicians in their professions has received the general attention of all nations in the world. Due to the devastations of the "Great Cultural Revolution," a considerable group of middle-aged and young scientists and technicians is not solid in basic knowledge, nor conversant in foreign languages, and their capacity and

environment for assimilating new knowledge are not ideal. Thus, the tasks of continuing education have become even more urgent, and we must adopt measures, formulate the necessary regulations and programs, ensure the required time and money, and earnestly strengthen work in this respect. We must encourage them to earnestly study the party's line, principles and policies since the Third Plenum of the 11th CPC Central Committee and understand how our party started from China's reality and enriched and developed Marxism in multiple ways. We must guide them to apply consciously the basic principles and methods of Marxism to the observation and study of actual problems and to their own acts. However, we must not require them to spend too much time on reading numerous Marxist classics. Their study time should be mainly spent on improving their professional ability.

2. Ideological Work

As a whole, the ideological-political foundation of China's scientific and technological communities is good. The vast number of scientists and technicians is enthusiastic in the four modernizations and courageous in expressing their views on the current reform, professional work, and momentous issues of the state. It is valuable and necessary to the achievement of an advanced democracy and constitutes an important guarantee for leaders at all levels to pool the wisdom of the masses and properly perform their duties. We should respect diverse views in the same way as we respect knowledge, talent, and the people's democratic rights. As long as they are expressed through normal channels, views of all kinds, including dissenting views, on party and state policies should be warmly received and earnestly considered. In terms of ideas which are not totally correct, or even erroneous, we must also take an attitude of goodwill and render enthusiastic help, including necessary criticisms and self-criticisms. However, we must never repeat such incorrect practices as quoting out of context, exaggerating criticisms, seizing upon one point and ignoring the overall picture, and allowing only criticism but not argument, nor the resorting to of administrative and organizational measures on ideological issues.

Of course, while receiving society's respect, scientists and technicians must also respect themselves, observe law and discipline in an exemplary manner, and serve as leaders in building a spiritual civilization.

3. Personnel Management System

In terms of the needs of the modernization program, China's scientists and technicians are still too few in number. However, the situation of overstaffing and leaving talent idle is found in some departments and units. The main cause rests in the management system. For a long time, China has followed the management system on administrative cadres for scientists and technicians, giving little consideration to the latter's characteristics and lacking in flexibility. Restricted by staffing, wage, and residence registration, they usually have little mobility. The employing units do not select personnel according to need. Once assigned, they become the "possessions" of the departments and units. It makes it even more difficult to rectify the irrational distribution of personnel. This type of management

system greatly suppresses their enthusiasm. Therefore, it must be reformed, in order to adapt to the needs of economic, scientific and technological, and educational reforms.

In recent years, China has begun to reform the scientific and technological personnel management system, mainly by means of the following measures.

(1) Creating Personnel and Scientific and Technological Interchange Organs, and Integrating Technological Transfers With Personnel Exchanges

In recent years, China's personnel and technology exchanges have made significant developments. According to incomplete statistics, from 1983 to 1984, regional personnel exchange organs throughout the country at the county level and above numbered 746, but in 1985 the number rose to 1,203, a 61 percent increase. In 1984, the exchange organs received 220,000 visiting personnel, and 16,000 of them went through transfer procedures. In 1985, they received 820,000 visitors, 120,000 of whom went through transfer procedures. The flow of personnel has also promoted the transfer of technology. Along with personnel exchanges, 261 technological achievements were transferred in 1984, and 900 in 1985.

The Central Committee's 1985 decision on reform of the scientific and technological system includes provisions on promoting personnel exchanges, experimentally introducing the appointment system, and permitting appropriate side jobs. Propelled by the Central Committee's and State Council's series of written instructions, the situation of personnel immobility has begun to change. According to statistics, the flow of scientific and technological personnel throughout the country constituted 2 percent of all scientific and technological personnel in 1983, and 3 percent in 1984. Though the percentage was not high, the orientation was basically rational. Several encouraging phenomena accompanying personnel flow have emerged: First, the orientation of the flow is mostly from urban to rural areas, and from research and teaching to enterprises. Second, the flow is shifting from personnel alone to a combination of personnel, technology, and equipment. Third, it is shifting from the simple flow of staff to attention on intellectual flow in diverse forms.

(2) Formulating Special Policies To Encourage Scientists and Technicians To Work in Rural and Frontier Areas and Minority Communities

Since 1983, the State Council and pertinent provinces, autonomous regions, and municipalities directly under the central government have adopted a number of special policies on scientific and technical personnel in outlying areas and the frontline of agriculture in regard to the terms of service, wages, and retirement. These policies have produced a certain impact on stabilizing and strengthening the scientific and technological ranks in outlying and rural areas. In Guizhou, Gansu, Nei Monggol and Xizang today, the trend of personnel outflow has been changed somewhat.

(3) Permitting Scientists and Technicians To Hold Side Jobs and Receive Reasonable Compensation

In 1982, the state granted permission to scientific and technical personnel to hold side jobs and receive reasonable compensation. The Central Committee's 1985 decision on reform of scientific and technological systems further provides: "On the premise of fulfilling their duties at their own posts and not infringing on the technological rights and economic interests of their own units, scientists and technicians may, in their spare time, perform technical work and render consultative service. In the case of utilizing the technological achievements, material and equipment of their own units, they should obtain the consent of such units and turn over part of their compensation." The policy has had a positive impact on promoting intellectual flow, interchange and osmosis between disciplines, full development of the potentialities of existing personnel, growth of medium and small and rural enterprises, and spare-time education. To strengthen guidance on spare-time side jobs, central leaders declared: Staff members are permitted to hold second jobs, but there must be measures of control, avoiding both noninterference and rigidity. In terms of social benefits, the advantages of permitting staff members to hold second jobs under controlled conditions exceed the disadvantages. Currently, the state is in the process of strengthening legislation on spare-time jobs, preserving the advantages and eliminating the disadvantages, in order to channel this reform measure in the right direction.

(4) Establishing Post-Doctorate Floating Research Stations and Experimentally Introducing Post-Doctorate Research Systems

In July 1985, with the approval of the State Council, China began to experiment with post-doctorate floating research stations and research systems. A group of outstanding young scholars with doctorates from domestic or foreign institutions of higher learning will be selected and promoted to the floating research stations and, after a certain period of research work, they will choose their work units according to the employment requirements of such units or accept assignments according to the need of the state and their own preferences. Currently, we have established 102 floating research stations for 250 post-doctorate personnel. The basic purpose of the system is: strengthening scientific research, training a large number of high-level experts compatible with the socialist modernization program and scientific and technological development, and promoting the interchange of personnel and disciplines.

(5) Introducing the Policy of Large Rewards to Scientists and Technicians Rendering Outstanding Service

In 1984, the state granted preferential treatment in working and living conditions to more than 400 scientists and technicians rendering outstanding service. Meanwhile, some 10 or more provinces, autonomous regions and municipalities directly under the central government, such as Shanghai, Jilin and Ningxia, also selected and promoted more than 2,000 local scientists and technicians rendering outstanding service. The policy has greatly aroused their enthusiasm.

As the various reforms in the personnel management system have just started, many difficulties have to be surmounted and many problems have to be solved. We must continuously review our experiences and proceed with this reform measure.

In 1986, the focus of the personnel management system reform is the overall introduction of the professional appointment system.

The reform of the technical title system and the introduction of the professional appointment system were initiated after searching and analyzing.

In September 1983, while temporarily suspending the work of technical title evaluation, China began to reform the professional title evaluation system on scientific and technical personnel.

In July 1984, China experimentally introduced the scientific and technical personnel appointment system in close to 70 units in some areas and departments. The core of the system is to grant certain autonomy to the employing units and the right of scientists and technicians to accept or refuse appointments.

In July 1985, the new system was experimentally introduced in 51 units in higher education, scientific research, public health, engineering, agriculture, and journalism. The title evaluation system, which is in the nature of functions and titles and denotes a life tenure, has been changed to a professional appointment system with clear requirements on functions and duties, proportionate limits and terms, and close links with wages. The experimental units have provided experiences for the national introduction of the new system. It will benefit the full development of the impact of professional and technical personnel on the four modernizations program, the strengthening of the post responsibility system, and the implementation of the principle of distribution according to labor, and promote the rational flow of personnel and the development of the economy, science and technology, and education.

On this basis and under the direct leadership of the Central Committee and State Council, we will, in 1986, proceed with the work purposefully and step by step. With this work as the focus, we will propel the reform of the scientific and technological [personnel] management system to develop in breadth and depth.

In addition to the three issues discussed above, we must also pay attention to the proper performance of intellectual work. In integrating importing technologies from abroad with solving key problems at home, for instance, we should, when deciding on projects, especially technological imports, give attention to the opinions of scientists and technicians in research organs and colleges and universities and recruit them to participate in the work of importing, digesting, assimilating and exploiting.

In short, so long as we say less hollow words and perform more solid deeds and truly respect knowledge and talent in each and every aspect, we will be able to perform intellectual work properly, create a fine environment for the emergence of talented personnel in large groups and the total use of their skills, and develop fully their intelligence and wisdom.

6080/6091
CSO: 4008/7

CHAPTER 4. REWARDING ACHIEVEMENTS

[Text] Section 1. Reward for Scientific and Technological Achievements

Scientific and technological achievements embody the talent and intelligence of scientists and technicians, management personnel and workers, and many are the crystallization of the energy and painstaking toil of a lifetime. Rewarding fine achievements is an important means to enhance the enthusiasm of the people in scientific research, inventions and creations, and technological improvements, a basic policy to develop our science and technology, and a major part of the management of achievements. To date, we have formulated regulations rewarding inventions, discoveries, progress, rationalization suggestions, and technological improvements, and gradually formed a relatively complete system of rewarding achievements. By recognizing the rights in inventions, discoveries and technological achievements, and protecting the status and honor of inventors, discoverers and creators of scientific and technological achievements, the state encourages their creative labor.

I. Invention Awards

(1) Formation of and Guiding Ideology for Invention Award System

As early as 1949, the "Common Program" passed at the First Plenum of the CPC Central Committee clearly stipulated the "vigorous development of natural science in order to serve industry, agriculture, and national defense, encourage discoveries and inventions, and spread scientific knowledge."

In August 1951, the Government Administration Council promulgated the "Decision on Rewarding Inventions, Technological Improvements, and Rationalization Suggestions Pertinent to Production" and "Provisional Regulations on Protection of Inventions and Patent Rights."

In 1962, the State Science and Technology Commission [SSTC] created the Bureau of Inventions. With the publication of "Regulations on Invention Awards of the PRC" by the State Council in November 1963, the work of rewarding inventions made a fairly significant development. Prior to May 1966, a total of 1,100-plus applications for invention awards was received; more than 250 awards were approved.

(2) Basic Substance of "Regulations on Invention Awards"

The basic substance of the 15-article "Regulations on Invention Awards" includes: requirements for issuance of invention awards, mechanisms in charge, procedures for application and approval, and principles on classes of awards and distribution of reward money.

A major invention must fulfill the following requirements: a) not previously in existence; b) advanced; and c) proved useful through practice.

The SSTC exercises unified national leadership over invention awards. Applications for award must be submitted through the chain of command according to the jurisdictional relationship. The SSTC's Invention Evaluation Committee is responsible for making appraisals and determining the classes of award, subject to the commission's final consideration and approval. Inventors are granted invention rights.

Awards are divided into four classes according to the impact and significance of the inventions and, upon approval, an invention certificate, a medal and reward money are issued. By approval of the State Council, the amounts of reward money were readjusted in April 1984.

The amounts of reward money after readjustment are as follows:

Class of award	Honorary award	Reward money (yuan)
1	Certificate and medal	20,000
2	Same	10,000
3	Same	5,000
4	Same	2,000

Invention awards approved after 1 January 1984 are issued the readjusted amounts. Inventions of special importance are given special-class awards. Applications for special-class awards are forwarded by the SSTC to the State Council for approval. Reward money is rationally divided among inventors according to their contributions; reward money for individual inventions belongs to the individuals.

Upon examination and approval by the SSTC, awards recommended by the Invention Evaluation Committee are published in newspapers, listing the names of inventions, main inventors and classes of award. Public opinions are heard for 3 months, beginning from the day of publication and, where there is no objection, awards are issued. In case of objections, the reporting department makes recommendations for ruling by the SSTC.

Awards are issued by the reporting department and, as a rule, no centralized ceremony is held.

(3) Survey of Invention Awards

Since the National Science Mass Meeting (1979-June 1985), 976 invention awards were approved, including 1 special-class, 21 class-1, 108 class-2, 489 class-3, and 357 class-4. (See Table 1)

Table 1. Inventions Approved for Awards, 1979-June 1985

Year approved	Number approved: Total	Special class	Class 1	Class 2	Class 3	Class 4
1979	43		1	12	24	6
1980	109			13	75	21
1981	123	1	2	10	56	54
1982	153		4	17	68	64
1983	212		5	18	108	81
1984	264		7	25	125	107
1985.6	72		2	13	33	24
Grand total	976	1	21	108	489	357

Scientific and technological inventions and creations add millions upon millions of assets to society. From its successful cultivation in the 1970's to 1983, the special-class award winning "long-grained hybrid rice," for instance, was planted in 101.24 million mu of land, cumulatively increasing output by more than 40 billion jin.

Statistics on the 976 inventions approved for awards show that the increase in revenue and savings in expenditures totaled more than 26 billion yuan, including 32 inventions with economic benefits at 100 million yuan or more. (See Table 2) Classification of award-winning inventions by industries is shown in Table 3.

Table 2. Inventions Producing 100 Million Yuan or More in Cumulative Economic Benefits

No.	Name of invention	Award class	Year approved	Inventor	Cumulative economic benefit (billion yuan)
1	"Lumian No 1" new cotton variety	Class 1	1981	Shandong Cotton Institute	5.148
2	Long-grained hybrid rice	Special Class	1981	National Hybrid Rice Cooperative Research Group	4.300
3	Transplanting rubber to North	Class 1	1982	National Rubber Cooperative Research Group	3.655

No.	Name of invention	Award class	Year approved	Inventor	Cumulative economic benefit (billion yuan)
4	Artificial cultivation of raft-type kelp	Class 2	1981	Shandong Marine Breeding Institute	3.000
5	Low-toxic vaccine for contagious equine anemia	Class 1	1983	Harbin Veterinary Medicine Institute	1.333
6	"Yuanfengzao" new rice variety	Class 1	1983	Atomic Energy Utilization Institute, Zhejiang Academy of Agricultural Sciences	0.800
7	"Mianyang No 11" high-yield high-grade new wheat variety	Class 1	1985	Mianyang Prefectural Agricultural Sciences Institute, Sichuan	0.832
8	"Jinyan 1-7" disease-resistant cucumber	Class 2	1984	Tianjin Vegetable Institute	Approx. 0.600
9	"Xushu 18" high-yield disease-resistant sweet potato	Class 1	1982	Xuzhou Prefectural Agricultural Sciences Institute, Jiangsu	0.556
10	Flexible shield support for false dip open face	Class 2	1981	Huainan Coal Mining Bureau	0.500
11	"Zongdan No 2" multi-disease-resistant hybrid corn	Class 1	1984	Crop Institute, CAS	Approx. 0.500
12	"Sidan No 8" high-yield hybrid corn	Class 2	1985	Siping City Agricultural Sciences Institute, Jilin	0.494
13	High-speed electro-discharge wire cutting technique	Class 3	1982	Shanghai Electric Meter Plant	0.488
14	"Heihe No 3" super-early maturing soybean	Class 2	1985	Heihe Agricultural Sciences Institute, Heilongjiang Academy of Agricultural Sciences	0.454

No.	Name of invention	Award class	Year approved	Inventor	Cumulative economic benefit (billion yuan)
15	Hog epidemic low-toxic vaccine	Class 1	1983	China Veterinary Medicine Supervisory Office and others	0.360
16	High-yield wheat "3217"	Class 2	1985	Baiquan Agricultural College, Henan	0.336
17	High-titanium vanadium-titanium magnetic blast furnace smelting technology	Class 1	1979	Panzhihua vanadium-titanium blast furnace smelting experimental group	0.321
18	"Yuanwu 02" self-breeding corn series	Class 2	1982	Atomic Energy Utilization Institute, Shandong Academy of Agricultural Sciences	0.319
19	New blight [-resistant] high-yield cotton "86-1"	Class 2	1985	Plant Protection Institute, CAAS	0.304
20	"Miecanying" No 1 and No 3	Class 2	1981	Liaoning Silkworm Research Institute	0.300
21	Semi-automatic relay block system	Class 2	1980	Signal Institute, Ministry of Railways Academy of Sciences	0.280
22	Jinggang mold-growing bacteria and fermentation technique	Class 3	1981	Shanghai Insecticide Institute	0.270
23	Sulfur anchoring process for concrete rail sleeper nails	Class 3	1982	Railway Construction Institute, Ministry of Railways Academy of Sciences	0.200
24	Float jet tray	Class 3	1982	Lanzhou Petroleum Machinery Institute	0.180
25	"Heinong 26" new soybean	Class 2	1984	Soybean Research Inst., Heilongjiang Academy of Agricultural Sciences	0.180
26	New design of flat-coil belt high-pressure container	Class 3	1981	Zhejiang University	0.150

No.	Name of invention	Award class	Year approved	Inventor	Cumulative economic benefit (billion yuan)
27	Nonglutinous round-grained rice recovery system C57 and hybrid "Liyou 57"	Class 3	1981	Rice Crop Research Institute, Liaoning Academy of Agricultural Sciences	0.135
28	Molecule screen dewaxing by vapor reabsorption	Class 3	1980	Huadong Chemical Engineering College	0.130
29	"Yuejin No 5" summer soybean	Class 2	1983	Geze Prefectural Agricultural Sciences, Institute, Shandong	0.107
30	Superfine nickel carbonyl manufacturing	Class 3	1982	Central Iron and Steel Research Institute, MMI	0.100
31	Antigenic varieties 52-128, 57-681 of high blight-resistant cotton	Class 1	1983	Plant Protection Institute, Sichuan Academy of Agricultural Sciences	0.100
32	Silicon-manganese-molybdenum hollow alloy drill steel and production technology	Class 3	1981	Central Iron and Steel Research Institute, MMI	0.100
	Total				26.612

Table 3. Classification of Award-Winning Inventions by Industry, 1979-June 1985

Classification	Number approved for award							Subtotal	
	1979	1980	1981	1982	1983	1984	1985.6	No.	%
Light & Textile Ind.	36	88	94	101	113	137	40	609	62.4
Agriculture & Forestry	3	2	11	6	18	11	8	59	6
Medicine & Health	3	9	5	11	13	17	23	81	8.3
Defense Industry	1	10	13	35	68	99	1	227	23.3
Total	43	109	123	153	212	264	72	976	100

(4) Mass Inventive and Creative Activities

Mobilizing the enthusiasm of the vast number of people in inventing and creating and supplying more achievements and personnel to China's modernization program constitute an important measure in implementing the "Regulations on Invention Awards" and properly performing the work. In recent years, China's mass inventive and creative activities have flourished.

1. Competitive Inventive Activities

Since 1982, the China Science and Technology Commission, Ministry of Education, CYL Central Committee, State Physical Culture and Sports Commission and All-China Women's Federation jointly organized and held two sessions of "National Youth Creation and Invention Competition and Science Symposium" in both Shanghai and Kunming and evaluated and selected 347 minor inventions, thereby arousing young people's fervor for science and exploration and tempering their creative and practical abilities. On the basis of young people's inventive and creative activities throughout the nation, the China Science and Technology Association selected 10 pieces of work and entered them in the "World Youth Inventions Exhibition" held in Japan in 1985, and won an award for excellence.

The "National Youth Invention Competition," focusing on daily-need industrial articles and jointly held by the CYL Central Committee and Ministry of Light Industry in 1982, was participated in by more than 3 million young workers and collected close to 100,000 minor achievements, producing a positive impact on the growth of China's light industry and the development of the socialist economy.

In 1983, on the industry-communications, finance-trade, and capital construction fronts, the State Economic Commission, All-China Federation of Trade Unions and CYL Central Committee jointly organized and launched the "National Young Workers' Five Small Ingenuities Cup Competitions," consisting mainly of "small inventions, small innovations, small remoldings, small designs and small suggestions." Over 10 million young workers of China's 29 provinces, autonomous regions and municipalities directly under the central government took part in the activities. According to the statistics of 12 cities, such as Beijing, Shanghai, and Harbin, by the end of 1982, young workers had made more than 100,000 achievements and created economic results valued at more than 60 million yuan.

In October 1984, Beijing formed the Youth Science, Technology and Inventions Club, with a current membership of more than 3,000. In 1985, they offered the "National Edison Cup Creation and Invention Awards," evaluated and selected a group of outstanding achievements, and greatly enhanced the enthusiasm of the vast number of young people.

In 1984, the magazine WOMEN OF CHINA and 10 other media units jointly held the "Young Women's Invention and Creation Awards Competition" and raised the young women's enthusiasm in inventing and creating.

2. The China Invention Association

At the end of 1983, more than 100 scientists, inventors and leaders of pertinent departments jointly proposed the formation of the China Invention Association. In September 1984, the Central Committee and State Council formally approved the application of the SSTC and All-China Federation of Trade Unions for its formation. After almost 1 year of preparations, the China Invention Association held its inaugural meeting on 16 October 1985, passed its "Constitution" and elected its leading mechanism. During this period, its preparatory office held in Beijing the "First National Invention Exhibition" and displayed 348 inventions.

(5) Participation in International Inventive Activities

From 19 to 28 April 1985, in the name of the China Invention Association, China took part in the 13th Geneva International Invention and New Technology Exhibition. It was the first time that we took part in international inventive activities. Eleven of the 19 items entered by China received awards at the exhibition, winning 14 cups and medals, making relatively good achievements, and gaining international attention and welcome. Award-winning items are shown in Table 4.

Table 4. Awards Won at the 13th Geneva International Invention and New Technology Exhibition

No.	Name of item	Kind of award	Award
1	Miniature solid state triple-sensitive (sensitive to moisture, dust, and touch) control device	World Knowledge Property Right Organization award to inventors of developing nations	Gold decoration
		Geneva International Invention Exhibition Award (electronics category)	Gold medal
2	Rope threading device	World Knowledge Property Right Organization best young inventors' award	Gold decoration
		Geneva International Invention Exhibition award (household science category)	Silver medal
3	Electromagnetic field stereoprojection	Geneva International Invention Exhibition Asian Region award	Cup
		Geneva International Invention Exhibition award (teaching method category)	Gold medal

No.	Name of item	Kind of award	Award
4	Movable gear deceleration device	Geneva International Invention Exhibition award (machinery-metallurgy category)	Gold medal
5	Iron-chromium-cobalt form changing permanent magnetic alloy	Geneva International Exhibition award (machinery-metallurgy category)	Gold medal
6	Protective film for heat treatment	Geneva International Exhibition award (machinery-metallurgy category)	Gold plate medal
7	Partial multi-image lens	Geneva International Exhibition award (optics and photography)	Gold plate medal
8	Knit fabric bolt coil length electronic inspection and measuring instrument	Geneva International Exhibition award (textile machinery category)	Silver medal
9	Diamond tool electric spark processing technique	Geneva International Exhibition award (machinery-metallurgy category)	Silver medal
10	Non-stop strong leak stopping technique	Geneva International Exhibition award (safety category)	Silver medal
11	High-grade double faced different-pattern art tapestry	Geneva International Exhibition award (industrial art category)	Bronze medal

II. Natural Science Awards

(1) Formation and Guiding Ideology

To enhance the enthusiasm and creativity of natural science researchers and reward achievements of major significance in scientific and technological development in explaining the phenomena, characteristics or laws of nature, in order to hasten scientific progress and promote the socialist modernization program, the state offers natural science awards.

In August 1955, the State Council published "Provisional Regulations on Science Awards Issued by the Chinese Academy of Sciences." In line with the regulations, the state issued 34 awards in 1957. To adapt to the needs of scientific and technological development, the State Council published in November 1979 "Regulations on Natural Science Awards of the PRC" (hereinafter referred to as "Natural Science Award Regulations").

(2) Basic Substance of "Natural Science Award Regulations"

The basic substance of the 11-article "Natural Science Award Regulations" includes: basic requirements for issuance of natural science awards, principles on classes of award and distribution of reward money, methods of recommendation, and examination and approval procedures.

The regulations provide that all collectives or individuals making achievements of major significance in scientific and technological development in explaining the phenomena, characteristics or laws of nature will, with the approval of the state, be issued natural science awards. Award winners enjoy the rights of discovery.

Natural science awards are divided into four classes, and a natural science award certificate, medal and reward money are issued for every approved item. Upon approval of the State Council, the amounts of reward money were readjusted in April 1984. The readjusted amounts are as follows:

Class of award	Honorary award	Reward money (yuan)
1	Certificate and medal	20,000
2	Same	10,000
3	Same	5,000
4	Same	2,000

Special-class awards may be issued for items satisfying the basic requirements and possessing special significance. Special-class awards will be issued by recommendation of the SSTC and approval of the State Council.

Awards approved after 1 January 1984 are issued the readjusted amounts of reward money.

The regulations further provide that, where a national science award is won by an individual, the certificate, medal and reward money belong to the individual; where it is won by a collective, the certificate is issued to the collective and the medal to the collective and individuals making the most contributions to the achievement, and the reward money is rationally distributed among those taking part in the project according to their merits.

Recommendations for natural science awards may be submitted under 10 or more joint signatures of the various research organs, colleges and universities, national academic organizations and assistant research fellows or persons of equivalent level or above.

The Natural Science Award Committee established by the SSTC evaluates and determines the items to receive awards and the classes of awards, and awards are issued after approval by the commission. Natural science awards are under the unified leadership and responsibility of the commission.

(3) Survey of 1982 Natural Science Awards

In July 1982, in line with the "Regulations on Natural Science Awards," the SSTC sponsored the National Natural Science Award Evaluation Conference. It was the second national natural science award evaluation activity since 1957. The items submitted for award were first examined and evaluated by the pertinent departments, commissions, organizations and experts in the field and, after reexamination by members of the Chinese Academy of Sciences, they were presented to the commission's Natural Science Award Committee for final decision. After the committee voted by secret ballot and the SSTC made the final decision, awards were issued at the National Science and Technology Award Mass Meeting in October 1982.

Winners of natural science awards totaled 125, including 9 Class 1, 40 Class 2, 49 Class 3 and 27 Class 4, and covered the following fields: 39 in mathematics and physics, 25 in chemistry, 28 in earth science, 15 in biology, and 17 in technological science. An award was issued to a British scholar for his outstanding contribution in studying the history of China's scientific and technological developments.

The awards revealed China's major achievements in natural science research since 1957 and served as a review of our research ranks. Many of the award-winning items were completed under unfavorable conditions during the time of serious difficulties in China's national economy between 1959 and 1961 and the 10 years of chaos [1966-1976]. Some achievements were not only the first in the field at home, but also internationally advanced. The awards embodied the party's and people's concern and encouragement of meritorious scientists and researchers and reflected the vigorous development on China's scientific research front since the Third Plenum of the 11th CPC Central Committee.

III. Scientific and Technological Progress Awards

(1) Formation and Guiding Ideology

The scientific and technological progress award system covers the broadest range and possesses the richest substance among China's science and technology awards. In the development of the national economy, modernization of the means of labor, conservation of manpower and raw material, improvement of product quality, large-scale increase in economic benefit, and changes in production and socioeconomic structures all hinge on the progress of science and technology.

"Scientific and Technological Achievement Awards" are an important part of scientific and technological progress awards. The National Science Mass Meeting in March 1978 issued awards to 7,657 major achievements in the 28 years since the founding of the nation. They were selected among more than 44,000 items evaluated and recommended by the various provinces, autonomous regions, municipalities directly under the central government, and State Council's departments in charge. Since 1979, the various provinces, autonomous regions, municipalities and State Council's departments in charge have successively formulated their own award measures to reward the

scientific and technological achievements of their own areas and departments, and produced a certain impact on promoting scientific and technological developments.

Nevertheless, scientific and technological achievements are only a part of scientific and technological progress. Many factors of technological progress resulting in major contributions to the national economy, national defense and management of science and technology cannot all be included within the category of scientific and technological achievement awards, e.g., the construction of key projects; research in and manufacture of major equipment; design, construction, production technology and management techniques in enterprise technological transformation; new scientific management methods; and work in information, calculation and measurement, and standards.

At the National Science and Technology Award Mass Meeting in October 1982, Premier Zhao Ziyang gave an important speech on behalf of the Central Committee and State Council. He declared: Though making no inventions or discoveries, many comrades perform creative labor at the various scientific and technical posts and have rendered important and even outstanding services to the promotion of technological progress and improvement of economic results; therefore, we should formulate technological progress award regulations on their behalf. The idea was totally compatible with China's reality and the desire of the vast number of scientists and technicians. In September 1984, the State Council promulgated the "Scientific and Technological Progress Award Regulations of the PRC" (hereafter referred to as "Scientific and Technological Progress Award Regulations"). The promulgation of the regulations was an important step in propelling China's scientific and technological progress and promoting its economic growth. It will further encourage the vast number of scientists and technicians to plunge into the work of promoting the economy and struggle for the magnificent goal of the modernization program and quadrupling output.

(2) Basic Substance of "Scientific and Technological Progress Award Regulations"

The basic substance of the 15-article "Scientific and Technological Progress Award Regulations" includes: areas and classes of awards, requirements for issuance of state-level awards, classes of state-level awards, procedures for application and examination and approval of awards, and provisions on provincial (ministerial, commission) level awards.

The sphere of awards includes: new scientific and technological achievements suitable for the socialist modernization program; popularization and adoption of existing advanced achievements; management of science and technology and work in standards, calculation and measurement, and scientific and technological information.

According to the scientific and technological level, economic benefits, social benefits, and impact on scientific and technological progress of the items submitted for award, scientific and technological progress awards are divided into state and provincial (ministerial, commission) levels.

Under the regulations, any achievement fulfilling one of the following conditions may be submitted for a state-level award.

1. Scientific and technological achievements suitable for the socialist modernization program (including new products, new technology, new techniques, new materials, new designs, and new biological varieties) which are a) first created in China; b) advanced in the particular field; c) proved by practice to be of major economic or social benefit.

2. Creative contributions and production of major economic or social benefit in popularizing, transferring and applying existing achievements.

3. Creative contributions and production of major economic or social benefit in construction of major projects, research in and manufacture of major equipment, enterprise technical transformation, and adoption of new technology.

4. Creative contributions and production of outstanding results in management of science and technology, work pertaining to standards, calculation and measurement, and scientific and technological information.

State-level scientific and technological progress awards are divided into three classes:

Class of award	Honorary award	Reward money (yuan)
1	Certificate and medal	15,000
2	Same	10,000
3	Same	5,000

Upon approval by the State Council, special awards are issued for achievements of special contribution to the socialist modernization program, and the reward money is of a larger sum than the Class 1 award.

Applications for state-level awards must be submitted through the chain of command according to the jurisdictional relations for evaluation and consideration, and awards are issued after examination and approval by the State Scientific and Technological Progress Award Evaluation Committee.

The committee is composed of 57 members, and under it are 22 professional evaluation groups, consisting of 399 experts.

The provinces, autonomous regions and municipalities directly under the central government and the State Council's departments in charge are to formulate separate regulations on requirements, classes and amounts of awards, evaluation mechanisms, and procedures of examination and approval.

(3) Survey of the Implementation of "Scientific and Technological Progress Award Regulations"

The "Scientific and Technological Progress Award Regulations" was first introduced in 1985. At its first meeting, the State Scientific and Technological Progress Award Evaluation Committee decided that, as major achievements completed prior to 1977 had been issued awards at the National Science Mass Meeting, only achievements completed after 1 January 1978 were eligible for the 1985 state-level awards (except special-class awards).

In May 1985, the science and technology commissions of the various provinces, autonomous regions and municipalities directly under the central government and the State Council's various departments in charge completed the preliminary examination of 11,655 achievements and made reports to higher levels.

In July 1985, the various professional evaluation groups completed the reexamination of achievements in their particular fields.

The State Award Evaluation Committee held two conferences in August and September 1985 and selected 1,772 items for 1985 state-level awards, including 23 special-class (already approved by the State Council), 134 Class 1, 537 Class 2, and 1,078 Class 3. On 18 October, 1,302 awards were published in newspapers (the remaining 470 unpublished). Upon expiration of the 3-month objection period, awards were issued in May 1986.

The distribution of state-level scientific and technological progress awards by industries is shown in Table 5.

Table 5. Distribution of State-Level Scientific and Technological Progress Awards by Industries

		Number of awards					
		Total					
No.	Industry	No of items	Percentage	Special class	Class 1	Class 2	Class 3
1	Machine	99	5.6		6	35	56
2	Electronics, instruments, meters	89	5.0		9	29	51
3	Chemical industry	82	4.6	1	2	25	54
4	Metallurgy	67	3.8		3	25	39
5	Mining	57	3.2	3	5	18	31
6	Light industry	44	2.5		2	16	26
7	Textile	23	1.3			8	15
8	Medicine and health	47	2.7		2	18	27
9	Pharmaceutics	23	1.3			5	18
10	Agriculture, animal husbandry, fishery	79	4.5		4	23	52
11	Forestry	24	1.4			8	16
12	Urban and rural construction	25	1.4			6	19
13	Construction of engineering projects	17	1.0	2	1	3	11

		Number of awards					
		Total		Spe-			
No.	Industry	No of items	Percentage	cial class	Class 1	Class 2	Class 3
14	Design and standards of engineering projects	39	2.2		3	13	23
15	Building materials	21	1.2			7	14
16	Water conservation, power	55	3.1	1	5	20	29
17	Communications, transportation	72	4.1		3	26	43
18	Standards of common usage	27	1.5		2	9	16
19	Natural disaster monitoring and forecasting	20	1.1		2	6	12
20	Safety, public security	21	1.2		1	4	16
21	Propagation of achievements, adoption of new technologies, digestion and assimilation of imports	282	15.9		15	69	198
22	Management of science and technology and information	13	0.7		1	2	10
23	National Defense Science, Technology and Industry Commission	485	27.4	15	57	145	268
24	General Logistics Department	60	3.4	1	11	16	32
25	Unclassified	1	0.1		1		
	Grand total	1,772	100	23	134	537	1,078

IV. Rationalization Suggestion and Technological Improvement Awards

(1) Formation and Guiding Ideology

To encourage workers in making rationalization suggestions, pursuing technological innovations, promoting the national economy and accelerating the socialist modernization program, rationalization suggestion and technological improvement awards, with the approval of the State Council, are offered.

In August 1954, the Government Administration Council promulgated "Provisional Regulations on Awards for Inventions, Technological Improvements and Rationalization Suggestions Pertaining to Production."

In 1963, the State Council decided to separate "invention" and "technological improvement" awards, published in November 1961 "Regulations on Invention Awards" and "Regulations on Technological Improvement Awards," and abolished rationalization suggestion awards. During the 10 years of chaos, "Regulations on Technological Improvement Awards" was suspended.

In October 1978, the State Economic Commission and SSTC reprinted and redistributed the "Regulations on Technological Improvement Awards" and reinstated the system.

In 1982, in view of the incompatibility of certain articles in the regulations with the practical situation due to changes in objective conditions, and in consideration of the necessity to reinstate rationalization suggestion awards, the State Council promulgated in March 1982 "Regulations on Rationalization Suggestion and Technological Improvement Awards."

(2) Basic Substance of "Regulations on Rationalization Suggestion and Technological Improvement Awards"

The basic substance of "Regulations on Rationalization Suggestion and Technological Improvement Awards," consisting of 20 articles in 5 sections, includes: requirements for awards; sphere of awards; classes of awards and jurisdiction over examination and approval; examination and processing; organizational leadership.

Where rationalization suggestions and technological improvements pertaining to production, after experimental studies and practical application, have created outstanding results in the production work of any unit, workers (collective or individual) responsible for such suggestions and improvements are issued awards in accordance with these regulations.

The substance of the regulations includes the following:

1. Improvement of industrial products and building structures and enhancement of their quality; improvement and development of biological varieties; development of new products.

2. Improvement of technical methods, experimental and inspection methods, and planting, plant protection, breeding and cultivation, safety, medical, health and labor protection, resource storage, conservation and transport techniques.

3. Improvement of tools, equipment, instruments and installations.

4. Technological measures leading to higher utilization of raw materials, materials, fuel, power, equipment, and natural conditions.

5. Improvement of designing, statistics assembling, calculation and other techniques.

The classes of awards are determined mainly by economic results (impact and significance where no direct computation of economic results is possible) of the items under consideration, produced in an entire year from the day of adoption. They are divided into four classes:

Class	Annual economic results (yuan)	Reward money (yuan)	Honorary award
1	1,000,000 or more	1,000-2,000	Certificate
2	100,000 or more	500-1,000	Same
3	10,000 or more	200- 500	Same
4	Under 10,000	Under 200	Commendation

Rationalization suggestion and technological improvement awards are examined and approved by the utilizing units and filed with higher-level departments in charge for the record.

Enterprises and businesses should create appropriate mechanisms or personnel for the work of examining, implementing and issuing awards. Disputes between the parties concerned and the examining units may be referred to the higher-level department in charge for handling.

"Regulations on Invention Awards" and "Regulations on Natural Science Awards" stipulate: Overseas Chinese residing abroad and foreigners may apply for invention awards and, after examination and approval, awards are issued according to "Regulations on Invention Awards"; persons in the field of natural science making outstanding achievements and major contributions to the development of China's science and technology are issued natural science awards according to "Regulations on Natural Science Awards."

Overseas Chinese, ethnic Chinese of foreign nationalities, and foreigners working in China making pioneering contributions to China's socialist modernization program and fulfilling the requirements in "Regulations on Scientific and Technological Progress Awards" may apply for state or provincial (ministerial, commission) level awards.

V. Conceptions on Reform of Science and Technology Awards

(1) Formulating "Law on China's Science and Technology Awards" and Considering New Forms of Awards

To enhance the legal efficacy of the four award regulations, we plan to formulate a "Law on China's Science and Technology Awards" on their basis, and clarify further the legal substance of invention, discovery and achievement rights. We will study new and higher state awards in order to give recognition to scientists and inventors making outstanding contributions.

(2) Perfecting Detailed Rules on Award Regulations

Since the implementation of the regulations on invention, natural science, and scientific and technological progress awards, we have accumulated certain experiences and encountered a number of new problems. In 1986, we plan to perfect these regulations by means of detailed rules and provisions. As certain articles in "Regulations on Invention Awards" are no longer compatible with the current situation, we have started on their revision, and plan to submit the revisions to the State Council in 1986 for approval.

(3) Reorganizing and Strengthening Evaluation Mechanisms

Evaluation committees created under the award regulations on inventions, natural science, and scientific and technological progress altogether have more than 50 expert evaluation groups, with close to 1,000 members. Constituting the core in making evaluations and awards, they have accumulated fairly rich experiences in practice. However, the differentiations and

labor divisions should be further refined. In view of the advanced age of some committee members and changes in work, reorganization is required. We need to reinforce the various evaluation committees and expert groups with a number of middle-aged scientists. Relative stability of committee members should also be maintained.

(4) Formulating Evaluation Criteria

To make the various award evaluations scientific, we need to formulate relatively stringent objective criteria and evaluation methods. We should utilize computers, determine the methods to compute economic benefits, and strive as far as possible for uniform yardsticks for the same professional fields.

(5) Creating State-Level Award Information Banks

The work of encouraging China's science and technology has been generally launched, and the numbers of award-winning achievements are increasing with the years. To adapt to the need of evaluation work, hasten the expanded application of award-winning items, promptly provide information on achievements and strengthen statistical analyses, the creation of award information banks has become a pressing matter. Currently, the work of building 14 invention award information banks has started, and we plan to complete state-level information banks within 1 to 2 years.

(6) Strengthening Centralized Management of State-Level Awards

On 22 May 1985, the State Council approved the creation of the "State Science and Technology Award Office" by the SSTC. To strengthen centralized management, we plan to place the implementation of the current regulations on invention, natural science, and scientific and technological progress awards and matters pertaining to award issuance all under the centralized management of the said office.

Science and technology award work has a strong policy and technical nature. Scientific and technological achievement management departments at all levels should strengthen leadership over the work, create the necessary mechanisms or assign special persons in charge, and perform the work properly.

Section 2. Management of Scientific and Technological Achievements

Scientific and technological achievements of theoretical value and practical benefit are the results of the creative labor of scientists and technicians and the vast number of laborers by means of observations, analyses, studies, research and manufacture or production practice. The basic substance includes achievements in natural science theories, applied technologies, patents, technological improvements, and understanding and remolding of nature by means of science and technology.

The tremendous impact of scientific and technological achievements on social development has been demonstrated in the history of the development of human

society. The accumulation of assets and the ceaseless improvement of material production cannot be separated from scientific and technological progress and the expanded application of scientific and technological achievements. Once materialized and producing an impact on the productive process, scientific and technological achievements rapidly push production to new heights. The ultimate goal of the management of scientific and technological achievements is precisely the realization of their materialization, turning them into society's real assets.

I. Formation of the Systems of Managing Scientific and Technological Achievements

Since the founding of the nation, with the continuous development of China's science and technology, the number of achievements has been growing year after year, the results of their popularization and application have become ever more obvious, and their management work has also made significant developments.

In April 1961, the State Council promulgated and experimentally implemented "Provisional Measures on Appraisal of New Products and New Technologies."

In September 1963, the SSTC formulated and promulgated "Provisions on Submission and Registration of Scientific and Technological Research Achievements (Trial Draft)" and, in conjunction with the conditions of their particular areas and departments, the science and technology commissions of the various provinces, autonomous regions and municipalities directly under the central government and the State Council's departments in charge formulated detailed rules and regulations for its implementation and created appropriate management mechanisms and contingents. The work of submitting and registering scientific and technological achievements gradually stepped on to a normal track.

In the 3 years between 1963 and 1966, a total of 10,176 achievements was formally registered with the SSTC, 35 issues of BULLETIN OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH ACHIEVEMENTS were published, and close to 1,000 achievements were included in the "Scientific and Technological Research Report," producing a favorable impact on spreading information, promoting interchange and application, mastering the conditions of plan implementation, and avoiding repetitions in research.

During the 10 years of chaos, the work of managing scientific and technological achievements suffered severe devastations.

After the Third Plenum of the 11th CPC Central Committee, science and technology received unprecedented attention from the party and government. The National Science Mass Meeting held in March 1978 issued awards to a group of major scientific and technological achievements and gave recognition to more than 1,000 advanced collectives and individuals on the science and technology front. Thereafter, the State Council successively promulgated regulations on invention awards, natural science awards, rationalization suggestion and technological improvement awards, and scientific and technological progress

awards, and the SSTC formulated "Provisions on Management of Scientific and Technological Research Achievements," "Regulations on Scientific and Technological Archives" and "Regulations on Scientific and Technological Confidentiality." Together with the administrative rules and regulations formulated successively during the same period, they have become the basic guidelines for the management of China's scientific and technological achievements during the current phase. Since implementation, relatively favorable results have been gained.

II. Management of Scientific and Technological Achievements

In managing scientific and technological achievements, China follows the three-tier system, namely, state, departmental and local, and basic, and the practice of combining centralization and dispersion.

The SSTC exercises centralized management of major state-level achievements.

Achievements belonging to the various provinces, autonomous regions, municipalities directly under the central government and State Council's departments in charge are separately managed by local jurisdictions and departments, which are responsible for appraisals, registrations, filing, encouragement, and interchange and popularization.

The various basic level units are responsible for the management of their own achievements.

Pursuant to "Provisions on the Management of Scientific and Technological Research Achievements" distributed by the SSTC, the various localities, departments and basic level units have formulated their own management measures and created appropriate mechanisms. According to 1985 statistics, full-time management personnel in the various areas and departments throughout the country numbered approximately 400-plus (excluding the China Patent Bureau and its affiliated units).

III. Appraisal of Scientific and Technological Achievements

Appraisal is the prerequisite for registration, popularization, application, and rewarding, a major link in management work, and an important means to evaluate the fruits of labor and ensure quality.

The "Provisional Measures on Appraisal of New Products and New Technologies" (hereinafter referred to as "Provisional Measures on Technological Appraisals") promulgated by the State Council clearly stipulates: All new products and new technologies must be promptly and earnestly appraised. After appraisal, conclusions on the degree of technological maturity, economic rationality, and conditions of application must be made, and popularization suggestions submitted.

The provisional measures also stipulate that different methods and steps of appraisal and design finalization must be adopted for different new products and technologies. Appraisals are divided into four levels, namely, state,

provincial (ministerial), prefectural and municipal (departmental, bureau), and basic. After appraisal and finalization, the departments in charge issue appraisal certificates for new products and technologies.

The provisional measures mainly focus on new products and new technological achievements. With the development of science and technology, achievements have grown ever more numerous and their ranges ever broader, and the items needing appraisal throughout the country number tens of thousands per year. In August 1985, the "Circular on Strengthening the Management of Scientific and Technological Achievements" jointly issued by the SSTC and State Economic Commission provides: Scientific and technological achievements must be strictly appraised. Appraisals may be made in diverse forms. All items based on written research and manufacturing assignments or contracts, and formally inspected, accepted and certified by the special departments in charge and making the assignments; all items proven in practice to be technologically mature and economically rational, inspected and tested, and found up to standard, and certified by the special departments in charge; all items inspected, found up to standard and certified by designated technological inspection and testing centers; all inventions and creations granted patent rights by the China Patent Bureau, placed in practical use, and producing economic results are regarded as having received appraisal conclusions. Where achievements in scientific theories have been published at national (or international) academic conferences, and have received affirmative evaluations in conference documents, no further organizational appraisal is required. When holding appraisal meetings, formalism must be avoided, the scale must be small, and attention must be given to thrift and practical results. No nontechnical personnel unrelated to the work of evaluation and appraisal may be invited. Technological experts in charge of appraisal work should be responsible for the work of making achievement appraisals.

IV. Submission and Registration of Scientific and Technological Achievements

(1) Procedure on Submission and Registration of Achievements

As a rule, scientific and technological achievements should be submitted to higher levels step by step through the administrative chain of command having jurisdiction over their creating units.

Basic level units should promptly report their achievements to the higher level units in charge. After examination and selection of items fulfilling the requirements for submission, the latter will make reports to the science and technology commission of their own levels and the higher level units in charge. After examining the items submitted to them and selecting those fulfilling the submission requirements, provincial departments and bureaus will forward them, together with signed comments, to the provincial, autonomous region and municipal science and technology commission and file copies of the "list of scientific and technological achievements reported" to the State Council's various departments in charge. Local science and technology commissions and departments should promptly examine and register the items received, and recommend those fulfilling the requirements of major state-level achievements to the SSTC within 3 months.

Upon receipt of items fulfilling the requirements of major state-level achievements, the SSTC will register them in the order of their receipt and publish them in its BULLETIN OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH ACHIEVEMENTS. When no objection is filed within 3 months after publication, the commission will issue a "Major Scientific and Technological Achievement Certificate."

(2) Survey of Registration of State-Level Achievements

After the publication of "Provisions on Submission and Registration of Scientific and Technological Research Achievements (Trial Draft)" in September 1963, the 1964-1984 (excluding 1966-1978) statistics indicate that 39,243 state-level achievements were reported, including 29,076 items completed after 1976. See Table 6.

Table 6. Number of 1964-1984 State-Level Achievements Reported

Number	Year	Quantity	Remarks
1	1965	18,167	
2	1979	2,820	
3	1980	2,687	
4	1981	3,371	
5	1982	4,186	
6	1983	5,397	
7	1984	10,615	
8	Total	39,243	

V. Interchange and Popularization of Achievements

The main purpose of interchanging and popularizing scientific and technological achievements is to apply them in production and convert the productive force in its intellectual state into a direct productive force promoting social development and creating actual economic benefits.

From 1949 until the period prior to the publication of the Central Committee's decision on reforming the scientific and technological system, the popularization and application of China's scientific and technological achievements mainly depended on administrative measures. The transfer of achievements was free of charge, and, though the pertinent departments held such activities as interchange meetings and exhibitions, research units and production departments basically took a passive attitude. Research units seldom showed any serious interest in the practical technologies urgently needed by production branches, while the latter had no adequate understanding of the importance of science and technology in enhancing quality and improving output. The interchange and popularization of scientific and technological achievements had no true impetus.

Early in 1982, the Central Committee relayed the SSTC's outline of a report on scientific and technological work. The principle of transfer of scientific and technological achievements for compensation was proposed in the

outline, and scientific and technological achievements began to enter the technological market in the form of commodities. After reform of the economic system, the expansion of enterprise autonomy and the introduction of the responsibility system have effectively aroused the enthusiasm of research and production units. Research units take the initiative to consider the urgent needs of production and popularize and transfer their achievements. Interest in the economic results of their achievements in production and transfer of achievements for compensation have increased the revenue of research units, improved their conditions, and enhanced their enthusiasm in popularizing and applying their achievements. After the expansion of enterprise autonomy and implementation of the responsibility system, production units have actively introduced new technologies, improved production conditions, output and quality by means of science and technology, and increased revenue. Reforms of scientific and technological and economic systems have promoted the close coordination of production with research, and an obvious and excellent momentum has gathered in the popularization and application of scientific and technological achievements.

After the publication of the Central Committee's decision on reform of the scientific and technological system, the technological market has vigorously opened up, commercialization of achievements has accelerated, and interchange and popularization have become more active.

VI. Filing of Achievements

Achievement files are a major part of science and technology archives and an important means of their preservation and reference. All pertinent departmental and local science and technology commissions and basic units must have an ample understanding of this point. They must act in strict accordance with the "Regulations on Science and Technology Files" issued by the SSTC, State Economic Commission, State Construction Commission and State Archives Bureau and the "Circular on Inspection of the Filing of Scientific and Technological Data" issued by the SSTC and State Archives Bureau.

VII. Conceptions on Reform of Achievement Management

(1) Formulating "Regulations on Management of Scientific and Technological Achievements of the PRC"

With the growth of science and technology, the management of achievements has become ever more perfected. A complete series of rules and regulations on achievement management, such as making appraisals, issuing awards, compensating transfers, and granting patent rights, has been formulated. It has produced an important impact on the popularization and application of achievements and the development of production. However, the current management system is not yet compatible with the demands of today's reform situation. Though the "Provisions on Management of Scientific and Technological Achievements" was formulated in 1984, as the patent law was not then implemented and the reform of the scientific and technological system was just starting, no concrete provisions have been made on the protection of ownership, relations between registration and application for patents, and

relations between transfer for compensation and confidentiality, and it is necessary to consider the formulation of regulations in order to strengthen management work.

(2) Formulating "Regulations on Appraisal of Scientific and Technological Achievements"

The "Provisional Measures on Appraisal of New Products and New Technologies" promulgated by the State Council in 1961 and currently governing the methods of making appraisals, has been in force for more than 2 decades and needs supplementing and revision. In the course of implementation, many new problems have emerged and some unhealthy tendencies have appeared, turning solemn appraisal work into a formality. Thus, we must promptly undertake the supplementation and revision of the "Provisional Measures" or formulate new regulations.

(3) Creating Achievement Management Information Banks and Reference Networks

As statistical analysis and archives management are important parts of the management of scientific and technological achievements and directly concern their popularization and application, we need to adopt modern management methods and scientific means. We should actively prepare to create scientific and technological achievement data banks and national reference systems, and strive to have them in operation in 2 to 3 years.

6080/6091
CSO: 4008/7

CHAPTER 5. LEGISLATION IN SCIENCE AND TECHNOLOGY

[Text] Along with the intensification of the reforms in China's economic structure and scientific-technological structure, the importance of strengthening legislation in science and technology is becoming increasingly obvious. An important step in China's legislation in science and technology was taken in 1985, and the socialist legal system appeared in a new field. To attain the lofty goal of quadrupling the gross value of industrial and agricultural output [GVIAO] during the Seventh Five-Year Plan, we must have a profound understanding of the relationship between science and technology and law, and continue our efforts to complete the basic work of legislation in science and technology in order to bring the legal system for science and technology gradually to perfection. Legislation in science and technology, accomplished in a planned and systematic way to suit China's socialist characteristics, is a matter of extensive, real and profound historical significance.

I. Science, Technology, and Law

The Constitution of the PRC solemnly announces that "the state promotes the development of the natural and social sciences, disseminates scientific and technical knowledge, and commends and rewards achievements in scientific research as well as technological discoveries and inventions." Promotion of science and technology is an important state function as well as a sacred mission according to socialist law. To understand the significance of and the position occupied by legislation in science and technology in the socialist legal system, we must first clearly understand the close relationship between modern science and technology on the one hand and law on the other.

Since the beginning of the 20th century, particularly after World War II, new phenomena have appeared in science and technology every day, and the social productive forces have continued to develop. Social and economic livelihood are now becoming increasingly complex and the intervention in and control of economic development according to the state's will through economic legislation has become an important task confronting all countries. A number of new legal branches concerning economic law, administrative law, labor law, and so forth, have appeared one after another. The law of science and technology has likewise appeared along with the advance of modern science and technology as a newly-emerging branch of the legal system.

The so-called law of science and technology is an epitome of the legal standards for the readjustment of social relationships in scientific and technical activities. Its appearance in the modern legal system is by no means coincidental. Science and technology are productive forces. "Labor productivity continues to develop along with the continued advance of science and technology." The development of social productive forces has enabled science and technology to infiltrate deeper into the sphere of social production and the social life of mankind and to produce a profound effect on traditional social relationships. This is the deciding factor for the practice of legal readjustment of the social relationships in scientific and technological activities, and this practice has become a more and more important component of the legal system.

Such are precisely historical facts. Up to now, the law of science and technology has developed in three different stages.

(1) Technical Standards--Embryo of the Law of Science and Technology

Technical standards were the beginning of the law of science and technology. Their appearance dated back to ancient times. This means that even when production was at a very low level, people had already learned from practice that certain natural laws are irresistible, and that violation of these laws would bring punishment and produce negative results for society. This was the time when the relationship between law and science and technology was first formed.

(2) Intellectual Property--Formation of the Law of Science and Technology

In the 19th century, along with the vigorous development of science and technology, and particularly the widespread application of scientific research achievements and technical discoveries in production, the term intellectual property came into being under conditions of capitalist commodity economy for the protection of inventions and discoveries in science, literature and arts. It must be admitted that this was only the starting point for the law of modern science and technology. Intellectual property was at first only a collective name for copyrights and patent rights. Now, it covers a wider area including the rights of invention and discovery, data program rights, and the rights of scientific and technical achievements, and its significance lies in the recognition of the personal and property rights of the scientific and technological inventors through legislation. Thus scientific and technical activities are subjected to readjustments with state laws.

(3) Macroscopic Rulings--Development of the Law of Science and Technology

After World War II, especially since the 1970's, it has been the vogue of the international legal system to use law as a means of macrocontrol over scientific and technical activities. In many countries, the focus of law is no longer on politics--a phenomenon that is familiar to us; it has been shifted to the economic as well as the scientific and technical fields. Among the laws promulgated in other countries during the past 20 to 30 years, the

proportion of scientific and technological laws has continued to grow. While formulating specific laws for science and technology, many countries have conducted active research in the formulation of the basic laws, explored the question of legislation for the new technical revolution, and strengthened the legal system to promote the application of science and technology in industry. It is now anticipated that, just as the new technical revolution is posing its challenge to mankind, a new wave of legislation in science and technology will also emerge in the realm of the traditional legal system. The continued growth of a close relationship between science and technology and law is shown in the following aspects:

First, science and technology form a huge industry in modern society. Along with the development of social productive forces, they have infiltrated into the state's political, economic, cultural, educational, military and diplomatic fields, and their own structure has also become increasingly complex. Therefore, in developing the system and the structure of science and technology; in working out policy decisions and plans for macroscopic science and technology; in the study and exploitation of microscopic science and technology; and in handling the relationship between macroscopic and microscopic scientific and technical activities, the state must use law as a means of control and readjustment.

Second, the advance of science and technology and the emergence of the new technical revolution have changed the social relations of mankind, and the factor of scientific and technical development must be considered in the branches of traditional civil law, criminal law, administrative law, economic law and international law. The series of new problems concerning the protection of computer software, the control of bioengineering, the social management of information, the rights of ocean space and air space, and so forth, should be solved with laws reflecting the pattern of scientific and technological developments.

Third, modern scientific and technical developments have provided advanced weapons for research in legislation, administration, judiciary, and the science of law. Systematic analysis and computer technology methods are being widely used in the formulation, execution, supervision and evaluation of law, and in the compilation of documents and retrieval of data. The latest achievements of science and technology are being increasingly absorbed into the system of law enforcement.

We can foresee that along with the emergence of the new technical revolution, the scope of law readjustment will expand into the wider sphere of science and technology, while the advance of science and technology will also lead to new changes in the traditional legal system and the structure of ruling by law. Modern law should bear the mission of readjusting social relations in scientific and technical activities. The main relations are as follows:

1. The vertical relations between the state's strategy, policy and plan of development and its organization and management of science and technology.

2. The horizontal relations between different departments and regions of the state, between different spheres of science and technology, and between the study, exploitation, management and coordination of science and technology.

3. The relations between the rights and duties of different scientific research entities, economic entities, other legal entities, and the citizens in scientific and technical activities.

4. The foreign relations formed in the course of international scientific and technical cooperation and exchange by the state, legal entities and citizens with their foreign counterparts and international organizations.

5. The relations between science and technology on the one hand and the political, economical, cultural, educational and other social activities on the other in their coordinated development.

6. The relations between people's subjective and objective worlds in modern scientific and technical activities, especially in regard to a comprehensive standard for the latest achievements in science and technology and in the work of management.

II. Reform Requires Legislation, Legislation Promotes Reform

In China, 1985 was the year of intensification in the reform of the science and technology management system. In accordance with the historical trend of the reform, legislation in science and technology, after several years of deliberations, has entered the stage of development. It is the important achievement of as well as the much needed weapon for the reform.

Shortly after the founding of the People's Republic, the state formulated 14 or 15 science and technology statutes including the "Decision on Rewards for Inventions Related to Production, and for Technological Transformation and Rational Proposals," and the "Provisional Rules and Regulations for the Protection of Invention Rights and Patent Rights." These statutes have greatly helped in economic recovery and technical development. However, because of the influence of the "leftist" line over a long period, and particularly the 10 years of severe turmoil during the "Great Cultural Revolution," China's legislation in science and technology, like the entire socialist legal system, was severely disrupted. After the Third Plenum of the 11th CPC Central Committee, and along with the development of economic legislation, the state formulated the "Regulations Concerning Rewards for Inventions," "Regulations Regarding the Natural Science Awards," and "Regulations Concerning Rewards for Rational Proposals and Technical Transformation," and promulgated a series of laws for scientific and technical work including the "Forest Law" and the "Environmental Protection Law." Thus, legislation in science and technology made a fresh start. However, the legal system of science and technology as a whole is still very weak. According to statistics, of the 58 laws enacted by the NPC and its standing committee up to the end of 1985, only two or three are related to science and technology. Again, of nearly 3,000 administrative statutes promulgated by the State Council, only 148, 1.5 percent of the total number, are science

and technology statutes. In fact, China's gigantic scientific and technological undertaking is still relying mainly on policies and administrative measures for readjustment. This is obviously incompatible with modern scientific and technical developments.

To strengthen legislation in science and technology, the legal organs of the NPC and the State Council have designated special groups to be concurrently responsible for the legislation, while the SSTC, during its initial structural reform in 1985, formed a legal organ to be responsible for the drafting of science and technology statutes. In August 1985, the SSTC and the NPC's Education, Science, Culture, and Public Health Committee jointly held the first session of a nationwide symposium on the work of legislation in science and technology. The participants discussed the position, role and significance of this legislation, summed up and exchanged their experiences, studied the long-range plans in light of the present and the future tasks in the reform, and deliberated on the revision of the "Technical Contract Law of the PRC (Draft)." In the reform, China's legislation in science and technology presented a brand-new outlook. Reform needs legislation, and legislation in turn promotes reform--this is a historical law. An important task in reforming the science and technology management system is to break down the stereotyped convention which is a hindrance to the orientation of science and technology to economic work, to the transformation of scientific and technical achievements into productive forces, and to the development of wisdom and creativity among the scientists and technicians; and to set up a new system that is compatible with the modernization of science and technology and rich in China's socialist characteristics. To attain this goal, we must affirm, in the name of law, the state's set principles and policies for scientific and technical developments, as well as the successful experiences of the millions upon millions of people in the course of the reform. Only thus can the "four modernizations" develop steadily, and the socialist motherland enjoy long-lasting peace. Therefore, legislation in science and technology is an urgent need of the moment.

China's science and technology are now developing vigorously. To accelerate the modernization of science and technology, reliance on policies alone is not enough. We stress the need for a legal system for the reason that the law of science and technology has certain attributes which are different from those of strategy and policy.

First, the law of science and technology embodies, as one of its attributes, the state's will which has an element of coercion. It deals with the rights and duties as stipulated by the state for administrative departments and establishments at various levels, enterprise organizations, social groups and citizens. It also recognizes, protects and develops the social relations and social order that are helpful to the modernization of science and technology, while its implementation is ensured through the state's coercive power. This law embodies very high authority, and the violation of it would bring civil or administrative punishment, or even criminal prosecution to the culprit. This is the attribute which policies do not possess. Of course, party and state policies can also be implemented in the form of law, although such policies must be elevated to the status of state law as enacted

or recognized by the organ of state power before they can produce the effects and power of law.

Second, the law of science and technology conforms strictly to standards. These standards are affirmative, clearcut and universally applicable. The party and state principles and policies for scientific and technical developments are the basis and guideline of legislation in science and technology, while the law of science and technology is the concrete expression, documentation and standardization of policies and principles. Through such rigid structural forms as hypothesis, processing, and sanction, and with distinctive qualitative and quantitative demarcations, the law of science and technology stipulates what people should do, what they are permitted to do, what they are forbidden to do, and the consequences of law violation in their scientific and technical activities. That is why legislation in science and technology is a necessary measure and the basic form to guarantee the implementation of the strategic policy decisions of the party and the state concerning the reform of the science and technology management system.

Third, the law of science and technology should be relatively stable. Our party has always decided on its own revolutionary strategy according to the conditions of struggles and the changes in tasks. Thus it is important that policies be flexible. However, it is also necessary for laws to be relatively stable. The elevation of the science and technology policies of the party and the state--policies which have been proved to be correct according to the practical experiences of the reform of science and technology management system--to the status of law is an important condition for the stable and sustained development of science and technology as well as a basic guarantee for the attainment of the lofty goal of socialist modernization.

III. Steps for Legislation in Science and Technology

Inspired by the spirit of the "Decision of the CPC Central Committee on the Reform of the Science and Technology Management System," the departments, regions and broad masses engaged in scientific, technical and legal work have undertaken some pioneering work to strengthen China's legislation in science and technology. This work can be summarized as follows:

(1) A Realistic Start in the Basic Work of Legislation in Science and Technology

1. Based on State Council planning, the "State Science and Technology Commission's Provisional Regulations Concerning Division of Work and Procedures of Legislation in Science and Technology" and the "SSTC's Provisional Regulations Concerning the Standardization of Science and Technology Statutes" were formulated. Practical experiments over the past year have shown their positive roles in ensuring the implementation of the principle of a high degree of democracy and centralism in the work of legislation, in increasing the efficiency of the legislation, and in improving the quality of the documentation.

2. Put in order the statutes of science and technology compiled since the founding of the People's Republic.

To be up to date with the basic conditions of China's current statutes of science and technology and to provide scientific data for legislation, since 1983, the SSTC has conducted a comprehensive check-up on the law of science and technology, the administrative statutes, and the departmental regulations that have been promulgated since the founding of the People's Republic. This check-up was basically completed in 1985. All the important statutes of science and technology were compiled to form the "Selected Statutes of Science and Technology of the PRC" Vol I and Vol II, which have become the important basic documents for legislation in science and technology.

3. Investigate and study foreign conditions of legislation in science and technology.

To learn from foreign experiences in legislation in science and technology, the SSTC, with the assistance of China's organs stationed in foreign countries, has conducted investigations and study in the existing statutes of science and technology and the trend of legislation in the new technical revolution among the legislative organs of more than 30 countries. Later, the "Report on Foreign Conditions of Legislation in Science and Technology" was submitted, and the following works were compiled or translated for publication: "Regulations Concerning the Development of Science and Technology as Provided in the Constitutions of Various Countries," "A Catalogue of Major Statutes of Science and Technology in Various Countries," "Japan's Six Laws of Science and Technology," "Collection of Japan's Government Personnel Laws," and other reference documents. The basic conditions of international legislation in science and technology was initially clarified.

4. Give publicity to legislation in science and technology.

China's first collection of essays on legislation in science and technology entitled "Legislation in Science and Technology--a New Field for Pioneers" has been edited by the State Science and Technology Commission and formally published by GUANGMING DAILY PRESS. In addition, an information network was established through the "Bulletin of Legislation in Science and Technology."

(2) Actively Implement the Work of Drawing Up Science and Technology Laws

In order that the work of legislation in science and technology may keep pace closely with the reform of the science and technology system, and help consolidate and develop the achievements of the reform under the principle of proceeding actively and prudently, the SSTC and other departments formulated the "Plans for Legislation in Science and Technology for 1985 and 1986" and submitted a tentative outline of the program of legislation in science and technology during the Seventh Five-Year Plan.

Thanks to the common efforts of various departments, the drafting, discussion and examination of the following important laws of science and technology and administrative statutes have already begun:

1. The Technical Contract Law of the PRC

This is an important law based on the need to accelerate the commercialization of technological results and the opening of technological markets and to readjust the relationship between the production and exchange of intellectual commodities. The drafting of this technical contract law was organized by the SSTC in May 1985. The first draft was distributed to various departments and regions in June 1985 for their comments. In the last 10 days of August, a national symposium on the work of legislation in science and technology was held, and the representatives of various departments and regions discussed the draft very thoroughly. Then the drafting group distributed questionnaires concerning certain matters of principle to more than 250 basic-level units throughout the country and went to 20 different provinces and municipalities for study and investigations. After obtaining a wide range of views and conducting study and investigations, the draft was revised many times before being submitted to the State Council for examination and deliberation.

According to the draft, the technical contract is based on the agreement between the legal entities, between the citizens, or between the legal entities and citizens regarding their rights and duties in the exploitation, transfer, or utilization of technology in serving the society. In light of China's realities, technical contracts are classified into three major categories, namely, technology exploitation contracts, technology transfer contracts, and technology service contracts. Technology exploitation contracts refer to those technical contracts between the parties engaged in the research and exploitation projects for new technology. These contracts are further divided into entrusted exploitation contracts and cooperative exploitation contracts according to the relationship between the rights and duties of the contracting parties. A special feature of these contracts is that the relationship between the parties' rights and duties lies in the exploitation of unknown technologies and their application. Technology transfer contracts refer to those contracts signed between the contracting parties for the transfer of patent or nonpatent technologies, and include contracts for the transfer of patent rights, contracts concerning permission for the working of a patent, and contracts for the transfer of nonpatent technologies. A special characteristic of these contracts is the transfer of existing technologies among different entities. Technology service contracts are based on the agreements reached among the contracting parties regarding the utilization of the technologies, knowledge, information and experiences in serving the society. They form a special portion of social service including consultation service, auxiliary service, intermediate service and various social services involving science and technology. The draft clearly stipulated that the signed contracts should be based on the principle of voluntary participation, equality, mutual benefits, cooperation, and compensation. The relationships between the subject and the object, and between rights and duties; the conditions for conclusion, alteration, and abrogation of contracts; and the systems of mediation, arbitration, and litigation are also set forth in the draft. Furthermore, a whole set of statutes dealing with such matters as the protection of intellectual property in the relationship between the production and exchange of intellectual

commodities, secrecy for patent technologies, the sharing of benefits from scientific achievements, responsibility for risks, responsibility for infringement of rights, prevention of unfair competitions, and so forth were also enacted.

2. Law of Scientific and Technical Societies of the PRC

This is an important law drafted by the SSTC in collaboration with the Chinese Scientific and Technical Association, the Chinese Academy of Sciences, and some other units since October 1985. After repeated discussions of this draft by national academic associations in Beijing, questionnaires were sent to various provinces, autonomous regions and the municipalities directly under the central government. Further revision of the draft is in progress.

Science and technical societies include many different types of natural science associations, and research institutes and associations. They are academic organizations of scientific and technical workers formed under the principle of voluntary participation. In the course of scientific and technical development, academic societies have always served as the breeding ground of new academic ideas, the hotbed of scientific inventions and discoveries, and an important strategic position to promote the development of science, the lateral flow of technologies, and the popularization and dissemination of scientific knowledge. At present, more than 130 academic societies have joined the Chinese Scientific and Technical Association. There are still more than 100 such societies which have not yet joined it. If the local academic organizations are also taken into account, they will combine to form a strong science and technology reinforcement. However, apart from the "Provisional Regulations on the Registration of Social Groups," published by the People's Central Government on 19 October 1950, legislation for social groups has been nonexistent for a long time, and not a single substantial law has been enacted. Therefore, based on the requirements for the modernization of science and technology, the enactment of a law for scientific and technical societies is an urgent and important creative task in China's legislation in science and technology. Accomplishment of the fundamental task of legislation in science and technology will help protect the legitimate interests of the scientific and technical societies, clarify their rights and duties, and bring into play the role of various academic organizations in enriching science and technology, promoting scientific development, discovering and training scientific and technical talent, disseminating scientific and technical knowledge, and developing socialist material and spiritual civilizations. It will also help introduce a legal system in the management of China's scientific and technical societies.

3. The Atomic Energy Law of the PRC

This is an important law drafted by the SSTC in collaboration with nearly 10 different departments including the Ministry of Nuclear Industry, Ministry of Water Resources and Electric Power, and Ministry of Machine-Building Industry. After repeated discussions and revisions, this draft is now more mature and closer to perfection.

The objective of formulating the atomic energy law is to encourage the research and development of science and technology for atomic energy, to ensure the rational exploitation and utilization of nuclear resources, and to promote the use of atomic energy in times of peace for the benefit of the Chinese nation as well as the whole of mankind. The draft defines China's administrative structure for atomic energy, and sets forth the basic principle for the state's nuclear development as well as the regulations for the research, application and development of the science and technology of atomic energy, the control of nuclear materials, nuclear fuels, and nuclear installations; the treatment and disposal of radioactive waste; the legal channels of international cooperation and exchange in the area of nuclear power; and a rigid system of punishment for the violation of regulations.

The atomic energy law is a set of basic laws for China's nuclear power, as well as a set of science and technology statutes of a professional nature. Its formulation and implementation will give a powerful impetus to the development of China's nuclear energy.

4. Regulations for the Protection of Biogenic Fossils of the PRC

These regulations are embodied in a set of laws drafted by the SSTC in accordance with the proposal of the Law Committee of the NPC Standing Committee, and in collaboration with the Chinese Academy of Sciences, the Ministry of Geology and Mineral Resources and some other units.

With its huge territory and long history, China has abundant biogenic fossils. These fossils are the historical witnesses of the earth's development, a record of the origin and evolution of life, and the state's precious assets. For a long time, in the absence of any law to protect them, China's biogenic fossils have been seriously destroyed, or allowed to drift out of the country. Therefore, strengthening the protection and control of these fossils through legislation in order to promote their rational exploitation and utilization is of great significance to China's scientific research, geological surveys, and economic construction.

China's socialist laws belong to a multilevel structure. While formulating these laws in 1985, China also enacted a series of administrative statutes to help solve some urgent problems in the reform of the science and technology system. The statutes which have already been submitted to the State Council for examination and deliberation, or have been publicized contained certain regulations concerning the enlargement of decisionmaking power for scientific research institutes, the decision on the formation of a natural science foundation committee, the interim regulations concerning the reform of the funding system in science and technology, and the several regulations concerning the promotion of a rational flow of scientific and technical personnel.

(3) Greatly Strengthening Theoretical Research in the Law of Science and Technology

Law is a science, and the law of science and technology is an organic combination of the standards of law and technology. It is also a frontier

science between natural and social sciences, now in the exploratory stage even in foreign countries. To promote the development of a legal system for science and technology, research in the science of legislation in science and technology has been included in the plans for the state's soft scientific research since the second half of 1985.

The soft scientific research in legislation in science and technology will be conducted under the principle of combining international comparisons with domestic research, combining scientific and technical circles with legal circles, and combining theory with reality. The research report should contain not only evaluations of the conditions in the major countries of the world, but also the proposals and programs of a policy decision nature for planning in legislation in science and technology.

IV. The Outlook of Strengthening Legislation in Science and Technology

Legislation in science and technology is a gigantic social engineering project that is just now beginning. We must fully recognize and assess the arduous and complex nature of this work, and make great efforts to improve the division of work and coordination of functions between legislation in science and technology on the one hand, and administrative legislation, economic legislation, labor legislation, and education legislation on the other. In actual work, we must solve the problems affecting the close coordination of legislation with the reforms in the science and technology system and in the economic structure in order to promote their coordinated development. After some practice, we should strengthen the organization, train cadres, create new theories of law, and explore new ways of ruling by law, so that China's legislation in science and technology will be subordinate to the reform and serve the reform. The achievements in the reform of the science and technology system should also be further consolidated and developed.

During the Seventh Five-Year Plan, the main objective of China's legislation in science and technology is to continue to open some new prospects that will meet the general demand for socialism with Chinese characteristics, conform to the general policy of opening the country to the outside world and invigorating the economy at home, and fit in with the reformed science and technology system and the Seventh Five-Year Plan. We will gradually strengthen the basic legal system for science and technology so that China's socialist law of science and technology will develop into an integral system.

To achieve this objective, the specific requirements in our present and future legislation in science and technology are as follows:

First, we must clarify the guiding thought that the legislation is intended to serve the reform, the Seventh Five-Year Plan, and the four modernizations. This is not only the basic aim of legislation in science and technology and the stand it should take, but also the criterion for determining or weighing the merits and shortcomings of the legislation.

Second, we should gradually strengthen the structure and organization of the legal system for science and technology.

Third, we should work out a legislation plan and an annual plan for science and technology, and strengthen the legislation in a planned and systematic way.

The plan and program for legislation in science and technology is the blueprint of a science and technology legal system. Working out the plan and program will help in developing China's law of science and technology into a rational system, in coordinating the legislation in science and technology with economic legislation, administrative legislation, and education legislation, and in the harmonious division of work, the acceleration of legislation, and the improvement of its quality among various departments and units.

Fourth, we should mobilize the initiative in both the scientific and legal circles, strengthen the cooperation between the scientific and economic circles, and make greater efforts in the formulation of the basic law of science and technology and the administrative statutes.

In 1986, increased efforts should be made on the following jobs:

1. To complete the "Technical Contract Law of the PRC," proceed with the drafting of "Regulations of Technology Exploitation Contract," "Regulations of Technology Transfer Contract," "Regulations of Technology Service Contract," and "Regulations of Technology Market Management," and the standardization of technical contract forms.

2. To conduct serious discussions and examinations of the "Atomic Energy Law of the PRC" and to proceed with the drafting of the supplementary regulations, the detailed regulations, and the safety rules.

3. To conduct serious discussions and examinations of the "Scientific and Technical Societies Law of the PRC," and to proceed with the formulation of regulations on the registration and management of scientific and technical societies as its supplement.

4. Strive to complete the examination and deliberations of the "Regulations for the Protection of Biogenic Fossils of the PRC" and organize the drafting of the relevant regulations and standards of management.

5. To organize research in the formulation of "Law of Scientific and Technical Research Institutes (name tentatively used)." This is a priority in the legislation in science and technology in 1986.

Fifth, we should step up our research in the theories and methods of legislation in science and technology so as to raise the legislation to a higher level.

When the first national symposium on legislation in science and technology was in session in 1985, the representatives of various departments and regions proposed the founding of a nationwide liaison group of science and

technology jurisprudence and legislation in science and technology. This organization is the first of its kind in China. After thorough preparations, this liaison group is making every effort to form the China Science and Technology Jurisprudence Research Institute as soon as possible. In addition, to meet the needs of scientific and technical developments, we should streamline the relationships between the financial, taxation, pricing, credit and banking systems on the one hand and the legislation in science and technology on the other. Then in the course of the legislation, we may use the mechanism of economic levers to bring about the harmonious development of science, economy, legislation in science and technology, and economic legislation so that they will cooperate among themselves and play a greater role in socialist construction.

Sixth, we should greatly strengthen the publicity work and education in legislation in science and technology, disseminate the knowledge of the law of science and technology among the scientific and technical workers, and train a new generation of legal talent in science and technology.

Science and technology political projects are a cause of millions upon millions of people in China. To establish a legal system of a high order for science and technology, we need not only a large contingent of specialists who have the knowledge of natural science and law and the experience of scientific and technical management, but also a high legal standard for the entire scientific and technical front and the people as a whole. Therefore, beginning in 1986, the SSTC will set up training classes for scientific and technical cadres in the hope that in 3 years, the comrades attending these classes will be able to completely master the theories of socialist jurisprudence, the most up-to-date knowledge of legislation in science and technology, and the theories and methods of managing science and technology with legal means, and to train a new contingent of legal talent for science and technology.

9411/6091
CSO: 4008/7

PART III. RESEARCH AND DEVELOPMENT

CHAPTER 1. DEVELOPMENT PLANNING

[Text] Scientific and technological development planning is the objective and concrete expression of S&T development principles and policies. It reflects the level of S&T development and the progress of S&T system reform in China.

Today, science and technology has permeated every aspect of society and economy, with economic development relying more and more on progress in S&T. Science and technology should march in the van of economic construction to give "staying power" to long-range economic development.

The development of science and technology has been growing at an unprecedented rate. At present, international competition is focused on strength in science and technology. The foundation of China's S&T undertakings is weak and its economic strength is limited while the S&T problems that need to be solved for national development are increasing in number. Formulating a correct S&T development plan under these circumstances is of major significance to both short- and long-range development.

Since 1956, China has formulated four long-range S&T development plans which have played an important role in the balanced development of China's science and technology, economy, and society. There have been mistakes and setbacks, but China's socialist system intrinsically guarantees that we have the ability to mobilize and organize S&T forces to carry out a rational division of work and vigorous coordination and solve S&T problems in accordance with targets and major projects. Consequently, we have made the most of our limited national strength, fairly quickly raised China's S&T level, and made contributions to the "four modernizations."

1. Composition of the Planning System

The S&T development plans that China formulated during different periods have different contents and requirements but their guiding principles share some common ground.

A. Set planning goals according to national conditions in different periods;

B. Determine which fields should be given priority in development and choose planning projects according to the requirements of economic construction and social development and the trend of S&T development;

C. Strive to absorb advanced S&T achievements from abroad, raise starting points for China's research and development, and reduce as much as possible the gap between advanced world standards and ours; and

D. Pay attention to S&T development reserves and ensure that planning has in-depth arrangement.

Following these principles and through continuous development and improvement, China's S&T development planning has gradually formed a relatively complete system which consists mainly of the following parts:

A. It may be divided into three levels according to the time span:

Long-range S&T development planning which may cover 10 to 15 years;

Five-year S&T development planning (medium-range planning); and

Annual S&T development planning.

Among them, the long-range development planning basically is a tentative idea, a guidance S&T plan. The most important is the medium-range plan which parallels the state's 5-year economic development plans. It is focused on the major state S&T project plan formulated in close adherence to the requirements of short-range economic development and the state major task plan selected and formulated on the basis of the former plan. The annual S&T plan consists of annual arrangements made in accordance with the general orientation of the above-mentioned two plans and in light of major S&T problems which need to be solved immediately for state economic construction at the time. Combining long- and medium-range plans with an annual plan makes planning more flexible and practical.

B. It may be divided into the following according to the targets of planning:

State plan for major S&T projects;

State plan for major tasks;

State plan for major basic research projects;

State plan for major industrial experiment projects;

State plan for major technological import and assimilation projects; and

State plan for major S&T undertaking development projects.

The series of plans mentioned above should also include "state plan for the major S&T projects of social development."

C. Special-purpose S&T development planning:

This was formulated first in 1985. One is the "spark plan" designed to rejuvenate rural areas and serve the local economy which is a short- and

medium-range plan for the development of applied technology; another is the high-tech development plan designed to serve the long-range development of the economy. This is, according to the national conditions of China, a medium- and long-range project-oriented development plan based on the principle of "limited goal and concentrated development."

In addition, various departments and localities generally draw up their own S&T development plans which are also component parts of the whole S&T development planning system of China such as the "outline for the medium- and long-range plan of industrial S&T development and technological transformation," which was formulated in recent years, and the outline for the development planning of various major industries between 1986 and 2000.

2. The Situation of Several Plans

Since its founding, China has formulated four long-range S&T development plans respectively in 1956, 1963, 1978, and 1983. To a certain extent they have played a role in guiding and accelerating the development of China's S&T undertakings and made contributions to economic development, national defense construction, and social progress.

In October 1955, the scientific research planning work team of the State Council submitted a report on formulating a 12-year S&T plan. With the approval of the CPC Central Committee and the State Council, the planning work team began to organize the outline draft for the plan in January 1956.

A total of 757 scientists and high-level technicians participated in the formulation of this plan. By August 1956, they had completed the "outline for the long-range S&T development plan for the 1956-67 period (draft)," "57 major S&T tasks," and four appendices including "some evaluations of the 12-year plan." In October of the same year, the CPC Central Committee and the State Council approved this plan. The most important part of the plan was to adopt four major pressing steps to concentrate energy on developing electronics, automation, semiconductors, jet propulsion and nuclear technologies. Since then, China has gradually established from scratch a number of new technological fields.

The implementation of the first plan was satisfactory. In 1962, after a 7-year effort, the tasks of the original plan were basically completed. In order to better adapt to the new situation of China's socialist construction and catch up with the new S&T developments in the world, between spring 1962 and spring 1963, the central science group and the State S&T Commission, with the approval of the CPC Central Committee, joined efforts and formulated the "outline for S&T development plan for the 1963-72 period" on the basis of the 12-year scientific plan. This plan consists of six parts--major project plan, S&T undertaking development plan, special industrial and agricultural S&T plan, technological science plan, and basic science plan--a total of 77 volumes and 374 major research projects. During the initial period of implementation, this plan progressed smoothly and made outstanding achievements until it basically came to a standstill in 1966 due to the impact of the "Cultural Revolution."

After the smashing of the "gang of four" in 1976, the CPC Central Committee convened a national science congress in March 1978. The congress discussed and adopted the "outline for the S&T development plan for the 1978-85 period" and clearly pointed out that "science and technology are productive forces" and that "the key to the four modernizations lies in S&T modernization." During the formulating process of this plan, they analyzed and studied the gap between then advanced S&T situations in the world versus China and brought up major S&T issues needed to be resolved for state construction. They confirmed 108 major projects and eight major fields of development--agriculture, energy, materials, computers, lasers, space, high-energy physics, and genetic engineering. When the 1979, 1980, and 1981 annual S&T plans were formulated, various tasks specified in this plan were readjusted accordingly. In 1983, the "major S&T project plan for the Sixth Five-Year Plan Period"--namely 38 major projects (which will be introduced specifically in the following)--was formulated on the basis of the above-mentioned plan.

At the end of 1982, the State Council approved the "report on formulating a 15-year (1986-2000) S&T development plan" submitted by the State Planning Commission and the State S&T Commission, starting the work of formulating China's fourth long-range S&T development plan. Detailed work of formulation was carried out by the long-range S&T development planning office consisting of over 200 experts, professors, engineers, technicians and responsible comrades from the departments concerned under the State Council, the Chinese Academy of Sciences, and institutions of higher education.

The formulation of this plan consisted of two parts: spelling out S&T development tasks and studying technological development policies. A total of 19 planning groups--agriculture, energy, communications, iron and steel, nonferrous metal, chemical industry, coal and chemical industry, machine-building, electronics, medicine and health, environmental protection, textiles, food, basic research, biotechnology, large-scale integrated circuits and computers, computer software, optical fiber waveguide communications, and new materials--were established. Among them, many specialized in formulating both national and industrial S&T development plans. At the same time, a special technological demonstration group responsible for formulating several major technological development policies was also established.

Since the work of formulating the plan was carried out at different levels, in addition to the above-mentioned planning groups which were organized by the state, other planning organizations and institutions were established by the departments concerned under the State Council, the Chinese Academy of Sciences, and important regions as well. A total of 3,000 people participated in this work across the country.

This plan was formulated at a time when the new world technological revolution was rapidly gaining momentum and China's economic and S&T development was at a stage of strategic change.

This is a plan facing economic construction and social development while providing S&T reserve for state development in the 21st century. Its basic tasks include:

Relying on S&T progress and gradually popularizing in the traditional industries of China those advanced technologies which were widely adopted by economically developed countries in the 1970's or the early 1980's.

Studying and developing a group of new fields of technology, establishing several technology-intensive new industries, and opening up new avenues for achieving the strategic goal of "quadrupling" the gross value of national industrial and agricultural annual output by the end of this century. At the same time, we should ensure that new technologies which have made breakthroughs are widely used in traditional industries, thereby gaining greater economic results.

Making earnest and proper arrangements for the initial scientific research work of the Three Gorges project, the nuclear power plants, and other major state construction projects and solving major, critical technological problems that arise during the process of construction so that major construction projects can be built on the basis of advanced technology.

Making proper arrangements for the importation and assimilation of major technologies and the popularization and utilization of major S&T achievements, especially those major technologies transferred from military to civilian units.

Making proper arrangements with long-range S&T development in mind for a number of basic research projects. At the same time, we should pay attention to strengthening the groundwork for the development of S&T itself to continue to increase the ability of S&T development.

This plan consists of two major parts: long- and medium-range plans. For the long-range part of the plan, the "outline for the national S&T development plan during the 1986-2000 period (draft)" and outlines for the national S&T development plans of various major traditional industries and six fields of new technology (a total of 27 books) were compiled. Over 500 S&T projects were submitted for 27 industries including agriculture, coal, power, oil, iron and steel, nonferrous metals, petrochemical industry, coal utilization, machine-building, electronics, food, fodder, integrated circuits and computers, computer software, optical fiber communications, new materials, bioengineering, medicine and health, and environmental protection.

The medium-range part of the "Seventh Five-Year Plan" consists of a complete set of plans including:

the outline for the national plan for S&T development between 1986 and 1990 (draft);

the plan for major state S&T projects between 1986 and 1990 (draft);

the plan for major state industrial experimentation projects between 1986 and 1990 (draft);

the plan for major state projects on technological import and assimilation between 1986 and 1990 (draft);

key state projects on the development of S&T undertakings between 1986 and 1990 (draft);

the plan for major state basic research projects between 1986 and 1990 (draft); and

The explanation of major S&T projects between 1986 and 1990 (draft).

On the basis of the above plan, a state key S&T project plan (draft) for the "Seventh Five-Year Plan" period was also formulated.

In addition, people were organized to draw up outlines for the long- and medium-range plans for the S&T development and technological transformation of major industries.

3. Key Project Plans for the "Seventh Five-Year Plan" Period

The period of the "Seventh Five-Year Plan" is crucial to laying a solid foundation. S&T should make positive contributions to short-range economic and social development and also save energies and create conditions for economic ascent in the last 10 years of the century.

Concrete development principles are:

A. Starting from China's actual situation and focusing on the development of compound technologies that combine traditional and new technologies. The development and application of new technologies should aim at the technological transformation of existing industries and enterprises to help them quickly switch to the foundation of modern technology and management.

B. Giving priority to making proper arrangements for the new technology of major strategic areas such as agriculture, energy, communications, and raw materials; and for the development of high technology such as electronic information technology, biotechnology, and new materials and strengthening the links of technology transfer and assimilation according to the needs of national economic and social development. At the same time, coordinated arrangements should be made for those technological development projects which require little investment, yield quick and great results, and can be popularized on a large scale so as to hasten the step of changing S&T achievements into the productive forces of society.

C. Implementing the open policy, combining technology with trade, and, in light of China's actual conditions, vigorously strengthening technological imports and international S&T exchange and cooperation.

D. Attaching importance to intellectual development and continued education to improve the quality and development ability of China's S&T contingent.

In order to achieve these goals and make them dovetail with the key S&T projects of the "Sixth Five-Year Plan," after the joint discussion of the State Planning Commission, the State S&T Commission, and the State Economic Commission, 76 projects, with a total of 346 subordinate projects, were selected out of the original 168 projects to be the key state S&T development projects for the "Seventh Five-Year Plan" period. Their main contents can be divided into the following four areas:

A. Major technology and equipment in industrial development

This category accounts for the largest proportion, includes a total of 34 projects, and is oriented mainly toward the economy. It is aimed at solving key S&T problems in industrial development.

In agriculture, efforts should be concentrated on seeds and food transformation, striving to renew and update the strains of China's major farm products such as cereal, cotton, and edible oil, improve their quality and resistance, and increase their output by over 10 percent during the "Seventh Five-Year Plan" period. Food transformation mainly is to develop fodder with emphasis on the development of fodder protein, compound feed, and the livestock, poultry, fish, and shrimp breeding industry.

In industry, the general demand is to catch up with the 1980's level of foreign countries and most key projects are designed to absorb and develop mature foreign technology and provide technology and equipment for major construction and technological transformation projects. They can be roughly divided into three categories:

1) The assimilation and supplementation of major imported technology such as the development of multichannel digital seismographs, the three-dimensional analog of underground oil and gas deposits, and improvement in the depth and precision of data processing.

2) Technology and equipment for which most parts are developed domestically only critical parts are imported such as steel-making with top and bottom dual-blown oxygen converters. In this field, efforts should be made to improve the dual-blown technique, increase the variety of steel products, and import necessary testing devices.

3) Technologies developed in accordance with China's salient features, for they often cannot be bought from abroad and some are still immature and in the research stage abroad such as uranium isotope laser separation and new lead smelting technologies.

B. The development of major products

This is arranged in view of domestic and foreign market demands, totaling 16 projects. They are mainly processing and transformation of light industrial,

textile, and farm products and highly processed metals and industrial chemicals. There are five categories:

1) Developing methods to highly process farm output and byproducts in accordance with market demand and the people's daily needs, developing food and industrial raw materials, and developing the breeding industry and improved breeds and strains.

2) Improving product quality and upgrading and updating products such as new modified varieties of chemical fibers and plastics.

3) Developing dominant products to increase exports and foreign exchange earnings such as textiles, genuine silk fabrics, and leather products.

4) Speeding up the development of products in short supply to replace imported products, such as new pesticides and phosphate and potash fertilizers.

5) Carrying out the processing and comprehensive utilization of natural resources such as the rare earths of Baotou City and the series of salt lake products of Qinghai Province.

C. The realm of new technology

The research and development of new technology is placed in an important strategic position in key S&T projects of the "Seventh Five-Year Plan." A total of 11 projects are planned.

Microelectronics and information technology are considered as forerunners in the field of new technology and given priority in arrangements. In regard to integrated circuits, efforts focus on the research and development of technologies needed to achieve economies of scale, especially such technology as ultrafine -processing. In regard to computers, efforts should focus on the development and application of microcomputers and vigorous development of CAD, CAM, and CAT technologies. In addition, arrangements are also made for the research and development of array technology and large computer systems. In regard to software technology, vigorous efforts will be made to absorb, study, assimilate and extensively apply mature foreign technologies and establish China's software standards. In regard to communications, emphasis is placed on solving problems in the application of optical fiber communications and ensuring that program-controlled digital switchboards are produced mainly domestically. Aside of military needs, the research of new materials is focused on the R&D of semiconductors, separation membranes, amorphous state, carbon fiber composite materials, and high-temperature ceramic materials. In regard to biotechnology, emphasis is placed on transforming a group of research achievements which have made or are about to make breakthroughs in productive forces such as microproteins and vaccine for B-type hepatitis virus which should be produced as commodities as soon as possible.

D. Social development

This mainly includes such areas as natural resources, ecology, environment, medicine, and public health, totaling 15 projects.

In natural resources, plans focus on the theory and technological methods for oil and gas deposits. In metal mines, emphasis is placed on nonferrous metals and the research and development of hidden mine prospecting techniques. National soil conservation is focused on the comprehensive treatment of the Huang He, Huai He, and Hai He, the Sanjiang Plain, and the Loess Plateau, on environmental research, on air and water pollution prevention, and on turning urban sewage into resources. Medicine and public health projects focus on the prevention and treatment of major diseases and the development of relevant pharmaceutics, pay attention to strengthening the continuation and development of traditional Chinese medicine, and make arrangements for research on traditional Chinese medical science and medicines and research on family planning and better parenthood.

In addition, efforts will be organized to carry out the "spark plan" during the "Seventh Five-Year Plan" period. The high-tech development plan is now being formulated.

4. The Implementation of Plans

A. The functions of development planning

Each and every one of China's S&T development plans is the fruit of much labor by thousands upon thousands of scientists, engineering experts, and managerial cadres, embodying the S&T development strategies, principles and policies of China in a given period. The basic role of an S&T plan is to guide the coordination of S&T, social and economic development by carrying out concrete projects. It has two functions: one is to guide the selection of projects in national research and development; and the other is to provide a basis for the state selection of projects required to be carried out during a certain period. Generally speaking, the major projects of a plan are brought up in light of the needs of economic development. It is very difficult for the state treasury to support the operation of all projects because it can only afford to finance a few projects specified in the plan. The many remaining projects of the plan will then be chosen by departments and localities according to their own needs and possibilities.

B. The coordination, management, and control of planned projects

Major state S&T development projects are included in the planning system of state economic development, transmitted to lower levels in a unified manner by the State Planning Commission, and coordinated jointly by the State S&T Commission and the State Economic Commission. Projects are generally managed by one or several leading departments.

The state exercises two kinds of control--direct and indirect--over planned projects. In the former, the State S&T Commission and the State Economic

Commission each join hands with various responsible departments to organize concerned research institutes, design institutes, universities, colleges, and production and construction units to break each project into several subordinate tasks and carry out full technological demonstration of such projects and subordinate tasks and then have every undertaking unit sign a contract with the state (a total of 1,467 contracts was signed for special key S&T tasks during the "Sixth Five-Year Plan" period). The latter is exercised mainly through the means of appropriations and guarantees for material conditions. Along with the growing progress of the reform of the S&T system, planning and management work is also changing accordingly. The demonstration of such a change is that the direct control and command plans of the state have been gradually reduced while indirect control and overall guidance have somewhat increased and that public bidding and contract systems are gradually replacing the method of allocating funds simply in accordance with the "blocks"--the division of departments and organs. The S&T project plan is developing gradually toward the orientation of merging research, development, production, and marketing into an organic whole. Some have already formed a coordinated process of systematic plans.

In 1985, the state implemented, on a trial basis, the public bidding system for major S&T projects. This is a major reform in the management, control, and funding system of planned projects. It will give greater vitality to the grass roots, help promote horizontal integration, and accelerate the process of turning research and development achievements into commodities.

C. Adopt effective measures to ensure the implementation of plans

Since all projects of the state S&T development plan are comprehensive projects involving many disciplines, departments (regions), and fields, they must be ensured with effective measures of many areas including administrative, economic, and organizational. Planned projects which are already being carried out should be readjusted in a timely manner in accordance with the actual conditions of economic and S&T development and they should be guaranteed with new measures adopted in accordance with the conditions after the readjustment.

In 1956, during the formulation of the 12-year long-range S&T development plan, four emergency measures were adopted in view of the fact that China's S&T foundation was extremely weak at that time and of the pressing situation that new technology represented by electronic, automation and computer technologies was booming. The four emergency measures were a measure to develop computer, semiconductor, radio electronic, automation, and long-distance technologies; a measure to carry out the application of isotopes; a measure to establish S&T information systems; and a measure to establish state measurement standards and carry out metrological scientific research. The first emergency measure in particular was implemented in the same year by those research organs which urgently needed it to be established, thus laying a foundation for the development of new technology in China and ensuring the implementation of the plan.

When the 10-year S&T plan was first implemented in 1962, in view of the needs of national economic readjustment, emphasis was placed on the research and development of nine major facilities. In 1983, in view of the needs of national economic development, the 8-year S&T plan which had been implemented in 1978 was reorganized into 38 key tasks, thus ensuring the implementation of this plan.

Since the founding of the country, we have accumulated many experiences and scored many achievements in the formulation and implementation of S&T development plans, but, according to the demands of the new situation facing us now, some problems still exist. These problems mainly include: the analytical foundation of China's S&T plan is still very weak; large-scale S&T statistics are in a starting stage; S&T evaluation work is basically nonexistent; the systematic planning system under which research, development, renovation, production, and market form a coordinated process has not been established; and data bases, S&T management and information networks, and expert consultation systems required by modern S&T planning are yet to be established and perfected.

Today, more and more countries are formulating long-range S&T development plans. In recent years, a series of international long-range high-tech development plans have further intensified this trend of development.

Facing this situation, China's S&T planning also needs substantial development. In the next few years, we will conscientiously sum up experiences, strive to adopt advanced planning methods and instruments and push the formulation of China's long-range S&T plan to a new level.

12302/6091
CSO: 4008/7

CHAPTER 2. TACKLING KEY PROJECTS

[Text] A basic method in the management and development of scientific and technological research is to zero in on a group of projects with vital national economic benefits and tackle them with the combined resources of all quarters. This has tremendous significance for accelerating the nation's science and technology and bringing about a number of technologies urgently needed in national economic development as soon as possible.

Ours is a planned economy. Before we go ahead with an economic project or plan, we must first solve its technological problems. At any one stage in the course of national economic development, therefore, we should put forward a number of scientific and technological projects which have to be tackled. The complexity of economic development and of modern science and technology is such that all these scientific and technological projects are multidisciplinary and require scientific and technological personnel from different sectors and professions getting together to cooperate in a systematic division of labor in research and development (R&D). Moreover, to put science and technology to practical use in economic construction without delay, we need to tie R&D, design, and engineering work more closely to one another. For this reason, we must mount a coordinated, comprehensive, and systematic drive on technology to remove the scientific and technological barriers in the path of economic development. In the 1950's, for instance, we had successes in semiconductor, computer, and other cutting-edge technologies; in the 1960's, we also did well in our nine major electrical machinery projects. To ensure smooth sailing for economic development in the Sixth Five-Year Plan and lay a firm technical foundation for the Seventh Five-Year Plan, we launched scientific and technological research on a large scale in the Sixth Five-Year Plan.

This was how we went about organizing scientific and technological research. First, we selected project priorities by studying the national economic development plan in conjunction with major engineering project plans and key technological transformation plans. To receive top national priority, a a project must have a significant impact on as well as be financially beneficial to the national economy; it must also be one where definite research progress has already been made, thereby making possible quick payoffs; and upon completion, it must be able to turn out popular marketable products or improve the quality of products so that the latter can be exported to earn foreign exchange. Accordingly, agencies such as the

State Science and Technology Commission assembled experts from all fields to conduct analysis, evaluations, and research to hammer out a plan of key research projects. Then the State Planning Commission, State Economic Commission, as well as the State Science and Technology Commission extensively sounded out all agencies concerned under the State Council and jointly worked out a national science and technology research plan for the Sixth Five-Year Plan, which was approved by the Fifth Session of the Fifth National People's Congress on 30 November 1982. The plan consisted of 114 topics under 38 projects in 8 areas: agriculture, consumer goods industry, energy development and conservation, geological and raw materials, machinery and electronic equipment, transportation and communications, high technology, and social development. After the plan was approved, the State Science and Technology Commission and the State Economic Commission, working jointly with other departments in charge, helped the research institutions, design units, institutions of higher education, and production units concerned to carry out full technological and economic verifications, analyze the projects, and determine the organizational format for each project according to the existing level of scientific expertise and areas where R&D was needed. Altogether 1,450 scientific and technological research contracts were signed. These contracts adopted a variety of methods including bidding, contracting with royalties, and contracting without royalties, and spelled out clearly the goals for each project and the obligations of each unit responsible for a particular project. In the course of research, the State Science and Technology Commission, the State Planning Commission, the State Economic Commission, and other comprehensive coordinating agencies regularly coordinated, inspected, and encouraged research in a broad range of projects. The various pertinent agencies under the State Council were put in charge of different projects. As the projects were completed, the state reviewed and evaluated them at the appropriate levels before accepting them. Award applications were made to state award-granting agencies on behalf of outstanding projects. After several years' efforts, the scientific and technological drive of the Sixth Five-Year Plan was by and large completed. In some areas, research even finished ahead of time, providing the construction of new plants and the transformation of old enterprises in China with advanced technology matching that of developed nations in the late 1970's and early 1980's. We successfully manufactured a complete set of polyester fiber short-fiber spinning and finishing machinery with a capacity of 15,000 tons a year. The technology of this machinery, now used in production, has so far been mastered by only a handful of countries. Scientific research on the comprehensive utilization of three major intergrown resources--Jinchuan, Panzhihua, and Baotou--shows us how technology can be relied on to transform old enterprises. Through research, Jinchuan Nonferrous Metal Company reduced its production costs by 30 percent within a few years and increased its profits by 240 million yuan, 40 percent of its total profits in the same period. Research on heavy-duty train haulage has borne fruit and is now being successfully applied to the construction of the main line between Datong and Qinhuangdao for transporting coal. The railroad will provide a modern means of moving outbound Shanxi coal. The achievements of scientific research in agriculture have been outstanding. Experimental plots planted with new wheat strains now account for one-tenth of all the acreage in the nation devoted to wheat cultivation, with yields rising by 10 percent on the

average. New materials R&D has supplied over 1,900 kinds of new materials to China's 10 major projects, including large-scale integrated circuits. By 1985, 90 percent of the special topic contracts had been successfully completed, narrowing the technology gap in some important science and technology areas between China and the world's most developed nations and changing the production technology in certain key industries in the national economy.

Section 1. Tackling Key Projects in Agriculture

During the Sixth Five-Year Plan, the emphasis of scientific and technological work in agriculture was to increase per unit area yield and the input-conversion rate, develop low- and medium-yield regions with tremendous potential for increased yields and input-conversion rate, utilize all kinds of agricultural resources systematically and economically, plan resource utilization, preservation, and development coherently, establish an ecological base for sustained agricultural development, adjust the agricultural structure and distribution rationally, exploit regional strengths, upgrade structural functions in the interest of multifaceted coordinated agricultural production, improve the technology of storage, processing, and comprehensive utilization of agricultural products by reducing losses and waste due to mildew and rotting, open up markets for popular products, and increase economic results. The scientific and technological drive in agriculture during the Sixth Five-Year Plan consisted of the following major projects:

1. Breeding Technology in Agriculture and Animal Husbandry

a. Selective breeding of major crops, such as rice, wheat, corn, cotton, rape, soybean, potatos, vegetables, and rubber. These new strains should be high-yield, disease-resistant, and hardy. These new products should have superior properties all-around and can produce bumper crops on a sustained basis. A system of breeding technology should also be established and perfected.

b. The selective breeding of livestock, poultry, and fish. By crossbreeding highly productive and lean pigs, we obtained 56 percent lean pigs. Sheep producing abundant quantities of fine good-quality wool were bred. also bred were chickens that laid large numbers of good-quality eggs while requiring little chicken feed, and fast-growing chickens producing yellow meat. Superior varieties of disease-resistant hardy freshwater fish were bred. There was also research on germplasm technology.

2. Comprehensive Technology To Increase Yields in Agricultural Regions

a. Comprehensive development and management technology for low- and medium-yield areas in the Huang He and Huai He plains, with emphasis on local agricultural development strategy, adjustment of agricultural structure, and the distribution of commodity bases, as well as an overall design for development. Technology was developed to turn weaknesses in resources into commodity advantages. Such disasters as drought and flooding and the presence of excessive alkaline in the soil were eliminated through technical development. Low-yield land was improved. Demonstration projects for the comprehensive development of various types of low- and medium-yield areas were designed.

b. Research on the comprehensive development of the Nenjiang, Heilongjiang, and Songhuajiang plains. The classification, distribution, quantity, and dynamics of agricultural and natural resources in the region were thoroughly studied and a qualitative evaluation conducted. A general plan was drawn up for the comprehensive development of the region and different kinds of demonstration projects and models were designed.

c. Research on the comprehensive development of the Taihu plains. The direction and course for the sound utilization of this region's water and land resources were investigated and a plan put forward to rationally readjust its agricultural structure. Related production technology was developed to turn resource advantages into high-quality high-yield output. All-round scientific experiments in agricultural modernization were conducted in the Taihu region.

3. Development of Feed Technology

We focused on technology to develop and utilize such feed resources as cottonseeds, vegetable seeds, sunflower seeds, and pig blood; the scientific preparation of pig, sheep, cattle, poultry, and fish feed; the processing technology and key equipment of premixed feed, condensed feed, and compound feed; the improvement of compressed pasturage and alkaline pasture; the technology of cultivating man-made grazing grounds; and the selective breeding of superior herbage strains.

4. Research on the Selective Breeding of Fast-Growth High-Yield Trees and the Comprehensive Utilization of Timber

a. Selective breeding of major fast-growth high-yield trees.

b. The comprehensive utilization technology of timber.

5. The Development of High-Efficiency, Low-Residue Pesticides

a. The technology of new varieties of high-efficiency, low-residue pesticides.

b. Research on the forms of pesticides.

c. Technology for the comprehensive prevention and treatment of major plant diseases and insect pests.

6. Research To Raise the Percentage of Phosphate and Potash Fertilizers as a Share of the Mix of Chemical Fertilizers

a. Research on magnesium and potash in salt lakes in Qinghai.

b. Sombrerite dressing technology.

c. The development of compound fertilizers and the scientific application of fertilizers.

Considerable progress has been made in all of the above areas.

Crop and livestock breeding: Over 30 new wheat varieties have been developed. Regional experimental plots have reached 40 million mu, 10 percent of the nation's total acreage devoted to wheat cultivation, with the increase in yield ranging from 5 to 10 percent in most cases. As many as 40 new rice strains have been developed, which were planted on 50 million mu over a 2-year period, with the increase in yield about 100 jin per mu. As for vegetables, there have been 46 new improved varieties, which are now being extensively popularized. The detoxification of the tip of the potato stem is being perfected. Now that we have mastered the technology of preventing the viral infection of potato causing regression and reduced yields, we have been able to increase yields by 50 to 100 percent per mu, and basically solved the technical problems of potato cultivation nationwide. Through crossbreeding, we have developed four kinds of high-quality, yellow-plumed chicken bred for meat and five fast-growth varieties, breeding 50,000 chickens, most of which are heavier than their local counterparts by 50 percent, while consuming one-third less feed.

The exploitation of key resources and the development of the technology of commodity production: The overwhelming majority of projects have met the various categories of economic targets laid down in the contracts and achieved remarkable results. Take, for instance, the high-density fish farm in the Taihu region, a new way of fish breeding using a water circulation system. Fish breeding is the primary purpose of the diversified breeding system, but it is supplemented by other aquatic animals and plants such as pearls, water chestnuts, and lotus roots. Making full use of inputs, we have been able to increase the fish output per mu three to four times compared to that at traditional local fish farms. Mutually supportive ecological and agrotechnical models for rice, grass, fish, and marten have been set up in the Nenjiang, Heilongjiang, and Songhuajiang plains and marshes. This represents an effective way to exploit and develop per unit area with minimal investments and maximum returns in an ecologically beneficial manner. In the beet-producing area in the Nenjiang, Heilongjiang, and Songhuajiang plains, an experimental production model was developed to improve ecological environmental products. This model has passed the experimental stage for mutually supporting "beet cultivation--sugar manufacturing--dairy cow raising."

The development of technology to increase yields over large areas: The Heilonggang area in Hebei Province was a low-yield disaster-plagued region. Using suitable farming technology and water-saving irrigation and applying fertilizers efficiently, however, it has raised grain output and cotton output per mu by 70 and 120 percent, respectively, in the core experimental area and the 4.5 million mu it impacted.

Experiments and demonstration projects in the comprehensive development and exploitation of low- and medium-yield areas: Using the theory and method of systems engineering and through aerial remote sensing and satellite magnetic tape analysis, the Chinese Academy of Sciences has produced pictures showing the water and soil conditions, biological resources, and the dynamic state of low-alkaline soil of the entire drainage area of the Xinxiang Natural Wenyan

Canal in Henan. Such pictures provide basic data for the quantitative and qualitative research necessary for this basin's comprehensive development and furnish a preliminary model for its dynamic development. Similarly satisfactory progress has been made in experiments in the comprehensive development of the Longwanghe Basin in Heilonggang, Hebei; in the saline-alkaline areas in Shangyin, Henan, which is prone to drought and flood; and in the Shajiang black earth region in northern Huaihe, Anhui.

Research on resource surveying and regional development planning: Using satellite information and relying primarily on optical imaging, the Chinese Academy of Sciences has processed almost 1,000 satellite pictures and completed as planned the survey on and qualitative evaluation of agricultural resources in the Nenjiang, Heilongjiang, and Songhuajiang plains. Armed with this scientific data, the Heilongjiang Planning Group has begun drawing up a plan for the all-round development of the Nenjiang, Heilongjiang, and Songhuajiang plains. Significant headway has also been made by the Chinese Academy of Sciences in its comprehensive study of the Taihu area.

Theoretical research and experiments: Important breakthroughs have occurred in research on the monitoring and forecasting of water and salt movements, on drought, flood, and saline alkalinity. Comprehensive region-by-region studies were conducted on the conditions for water and salt movement. The studies covered an 18,000-square-kilometer area at the northern tip of the route where the Nanshui is diverted northward. They resulted in over 20 diagrams of various kinds, a mathematical model and equation for forecasting water salinity, and principles, methods, and guidelines for regional division. If we can further improve on these achievements, we can apply them to regional monitoring and forecasting. We may even go one step further by taking specific measures to adjust the movement of water salinity to prevent subsoil salinization over vast areas and by providing a scientific basis for the comprehensive treatment of regions prone to drought, flood or saline alkalization.

Development of chemical fertilizer technology: An intermediate experiment using direct flotation to process calcium silicate was appraised and approved in December 1984 as planned. In one stroke, the grade of the concentrate was raised 10 percent and the recovery rates of magnesium oxide and phosphorous both reached the set targets. The experiment also provides advanced technology for the dressing of low- and medium-grade [lit: calcium silicate and phosphate] which presents dressing problems but accounts for 70 percent of China's phosphorous resources. Intermediate experiments were also carried out to find a process to make ammonium phosphate from the concentrates of phosphoric acid. As a result, we have now mastered the flow path techniques of extracting concentrated phosphoric acid-ammonium at the Kaiyang Phosphorous Mine where the ores have a relatively high magnesium content. We are also technically prepared to manufacture the equipment and upgrade the product. Product quality has reached the required standard and production is proceeding steadily, paving the way for the building of a plant in China to manufacture 12 tons of phosphoric acid-ammonium annually.

As for developing new pesticides, intermediate experiments in chlorothalonil were appraised and approved in late 1984. Both the percentage of original pesticides and recovery rate exceeded the targets in the contract and matched levels abroad. Used to prevent peanut rust, it can increase dried peanut output per mu by 90 to 100 jin and boost net earnings by 10 to 28 yuan. An intermediate experiment to build a facility capable of producing 80 tons of aldicarb annually was inspected and approved at the ministerial level in September 1984.

Section 2. Consumer Goods Industry

Consumer goods industries, such as light, textiles, and food industries, are China's chief exports and earners of foreign exchange. Generally speaking, however, the technology, processes, and equipment in these industries are still relatively backward and product variety and quality fail to meet the rapidly changing demands of overseas markets. This must be changed. Accordingly the following science and technology drive was launched in the Sixth Five-Year Plan:

1. Textile Industry

Focus: The two key areas of "chemical fiber spinning industry and equipment" and "textile printing and finishing technology." A total of 62 projects were involved, among which the major ones were:

Chemical fiber: We researched and developed a complete set of large-scale spinning and finishing machinery for short-staple polyester fiber, polyester fiber, filament equipment, and high-speed silk equipment. We developed high-efficiency, low-consumption, man-made fiber spinning technology that produces little pollution. We also developed new man-made fiber varieties such as network yarn, complex fiber, polyester fiber dyeable by certain dyes, and imitation silk.

Textile printing and treatment: Imitation wool and silk using chemical fibers, upscale printed cotton fabrics, upscale cotton knitwear, wool-like fabrics made of chemical fiber, chamois, and coated fabrics. Research was conducted on coat printing, foam printing, color batik, dark color-fast printing, and other new processes and technology involving the treatment of wool, hemp, and silk. Modern printing and dyeing machinery was manufactured to provide advanced facilities for the technical transformation of old and new plants in the Seventh Five-Year Plan.

By achieving the objectives of the scientific and technological drive, China's textile industry will no longer have to depend on imported plants for the growth of its chemical fiber industry as it did in the past. Moreover, it will be able to come up with high-quality chemical fiber products rich in variety and design and gradually put together a comprehensive system of technology. As far as dyeing and finishing are concerned, we will begin to come to grips with the important new dyeing, printing, and finishing technologies of the developed nations in the late 1970's and early 1980's, with consequent improvements in product quality approaching the most sophisticated in the world.

2. Leather Industry

Included in the Sixth Five-Year Plan were such key projects as research on the processing technology and equipment for upscale leather for pig-hide shoes, soft upper leather, upper leather used for making garments, leather for making suitcases, high-grade goat hide for making shoes, and leather used for making clothes. Also incorporated were projects to develop processing technology for the skins of rare animals and dyeing and refining technology for low-grade furs. Efforts were also made to coordinate key tanning equipment, industrial chemical materials testing equipment, and the comprehensive treatment of sewage.

After several years of hard work, the bulk of the projects was completed as required by the contracts and some products were almost as good as the best in the world. For example, high-grade goat aniline upper leather used in shoe manufacturing was judged by Italian experts to be almost comparable to similar Italian products in terms of quality. We already have the capacity for volume production. The grain side of high-grade pigskin and the fine-bred pigs have both been put into trial production. Garments, luggage, and bags made of grain upper pigskin have broken into the international market. In leather shoe production, the standardization of parts, assembly line production, and product diversification are gradually under way.

3. Plastics Industry

Polyvinyl chloride (PVC) is produced in bulk by China's plastics industry. Rigid plastics made of PVC are useful materials that can replace wood and steel. During the Sixth Five-Year Plan, the focus was on the development of rigid plastics in order to change the ratio of rigid and soft plastics. Another area of concentration was the processing and application of high-density polyethylene and linear low-density PVC resin. Efforts were made to broaden the application of plastic products. In addition, there was research on surface decorating technology.

After intensive research lasting more than 2 years, the vast majority of the projects have been completed in compliance with contract requirements. Some projects are now in trial production, after having been technically appraised and approved. They have put more plastics on the market and been highly successful. The production line for light foam materials has turned out over 10 categories of products for use by more than 100 units in such industries as the building of railroad cars, shipbuilding, and construction in 7 provinces and cities across the nation. By and large, linear low-density polyethylene films perform just as well as similar U.S. products. Compared to the usual low-density polyethylene films used in making large protective coverings, the linear variety can save about 35 kilograms of resin per mu.

4. Sensitive Materials

To expedite the development of sensitive materials in China and urgently fill some gaps in our product lines, we incorporated in the Sixth Five-Year Plan priority projects to develop new processes to make high-efficiency covering

power agent for X-ray film, X-ray film for medical use, one-step color imaging, and new varieties of printing film. In general, the majority of projects have now been completed as planned and some have passed technical appraisal, such as an X-ray film that can be used to photograph different sites in the human body. It is now in trial use in hospitals concerned. It is almost as good as the best in the world.

5. Food Industry

Research on the technology of food storage, preservation, and processing was carried out in the Sixth Five-Year Plan. Projects covered five major areas: grain storage technology; the storage and preservation technology of fresh eggs, aquatic products, vegetables, and fruits; the technology of breeding and growing sugar crops and sugar manufacturing; the processing and comprehensive utilization of the potato group of crops; and the technology of processing new varieties of canned and children's food. Many of these projects have already made significant progress and satisfied contract requirements. In a continuous 3-year experiment on preservation by membrane coating, 350 jin of eggs were stored under different conditions--normal-temperature warehouses, civil air defense works, and mountain caves--for 6 months through summer. Preservation rate exceeded 80 percent. Outstanding results were also registered in projects in the breeding of beets to produce high-sugar, high-yield strains and in the preservation of lychee. Turning to grain forecasting, systematic data are now in place, which can serve as a guide to scientific grain stockpiling in China. The selective breeding and domestication of yangtao has been extraordinarily successful and eight strains have been chosen as the best in the entire nation. High-standard bases occupying 5,000 mu have been set up, along with simple bases on another 5,000 mu. As for the processing and comprehensive utilization of the potato and related crops, the development of the starch line of products has borne fruits. Acetic acidic starch has been applied in production. The new process of making high-concentrate fructose syrup has achieved notable economic results. It is estimated that the mannitol project will be appraised at year-end. Work on processing equipment capable of making 1,000 tons of cornstarch from sweet potatoes is progressing smoothly and is expected to be completed on schedule.

Section 3. Energy Development and Utilization

The thrust of the Sixth Five-Year Plan was to accelerate research on energy development and energy conservation technology to pave the way technically for increasing primary energy output and rational utilization. Projects revolving around this included coal mining, coal conversion and combustion, nuclear energy, and the development of new energy resources.

1. Coal Mining Technology

During the Sixth Five-Year Plan, research concentrated on the mechanization of mine tunnelling and drilling injection technology in order to reduce the time required to drill a mine. Research was launched on comprehensive mining technology and equipment, while research on coal mining technology below

"buildings, rivers, and railroads" (the "three belows") and above Ordovician limestone water (the "one above") was intensified to fully tap the potential of existing mines and increase recovery rate. There were also research on coal mine safety technology, primarily to control gas and dust, research to make safety equipment, and research to perfect gas removal technology. Meanwhile, research to prevent and deal with karst streams in coal mines and lower dust concentration was also stepped up to enable coal production to take place in even safer conditions.

2. Research on the Development and Utilization of Oil Resources

The chief mission of the oil industry during the Sixth Five-Year Plan was to increase oil and natural gas stockpiles. Accordingly, scientific and technical research was directed at upgrading the prospecting technology of oil and natural gas and increasing their recovery rates.

Research on three-dimensional seismic prospecting technology has made significant headway, providing oil prospecting in east China, particularly where it takes place under complex, concealed geological conditions, with a complete set of equipment and coherent technology.

We also studied prospecting during highly aquiferous periods, heat extraction of thickened oil by steam injection, drilling using computer-optimized parameters, and the transportation of crude oil at normal temperature. Turning to the conversion of coal into gas, our research was systematic, ranging from resource appraisal to prospecting methods.

3. Research on the Development of Power Technology

These were the major research tasks we tackled during the Sixth Five-Year Plan: accelerate research on the vital technology in hydropower development; raise the technical standard of large generating sets, both thermal and hydroelectric; and work on the transmission and transformation technology of extra-high voltage alternating current and direct current. High earth and rock-fill dam technology is a form of dam construction technology that has become very popular overseas in recent years. Research on essential aspects of this technology was conducted in conjunction with the development of related hydropower stations. Other research had to do with the rapid construction of underground projects, and prospecting and treatment in geologically complex sites. To solve the problems of transmitting electricity over long distances from mine mouth power plants and newly built large hydropower stations, we conducted research on the technology of transmitting and transforming 500-kilovolt extra-high voltage alternating current and 100,000-volt direct current, thereby providing technology and equipment for China's inter-regional long-distance electricity transmission system. In addition, efforts were made to perfect a Chinese-made 300,000 kW thermal generating set and absorb and assimilate the technology of imported 300,000 kW and 600,000 kW thermal generating sets.

4. Energy Conservation Technology

We targeted energy conservation technology in industries that consume the most energy, such as metallurgy, chemical industry, and building materials industry. Among other things, we tackled such comprehensive energy conservation technologies as oxygen enrichment in blast furnaces by blowing fine coal, and oxygen side-blowing in open-hearth furnaces. We also researched and perfected technology and equipment for ingot casting, examined energy conservation technology in medium-sized synthetic ammonia plants, and developed high-quality, fire-resistant materials. Furthermore, we intensively worked on such new technologies as joint recurrent electricity generation by burning coal and gas and combustion gas turbines that burn heavy oil.

5. Coal Conversion and Combustion Technology

We emphasized research on pressurized fixed gasification and water coal tar pressurized gasification, set up an experimental furnace, and launched various gasification tests using different kinds of coal in order to provide urban gasification and the production of industrial synthetic gas with advanced technology and equipment. We also worked on the technology of fluidized-bed combustion using low-grade coal, that will provide new combustion technology and equipment for the effective utilization of that kind of coal.

In coal chemical industry, we stressed research to develop coal-based liquid fuels, including the large-scale production of methanol made from coal, and applied technology of mixed and unmixed low-carbon fuels in the hope that a way would be found to solve fuel shortages in coal-rich areas.

6. Nuclear Energy Development Research

The following projects were conducted to meet the demands of nuclear power development:

Research on the design of large-scale nuclear power plants and related basic research to pave the way for the assimilation of imported technology and the independent development of China's nuclear energy industry.

Research on the technology of nuclear heat generation. Under safe and economical conditions, research was carried out on heat generation using energy from nuclear power plants and on low-temperature reactors.

About nuclear fuels. In the near future, our emphasis will be on the enrichment of centrifugal uranium so as to furnish technology for plant construction in the 1990's. We will also work hard to combine the import of foreign technology with its assimilation to come to grips with the R&D for nuclear stations, and conduct research as appropriate on such new technology as laser, the disposal of nuclear fuels and the three wastes, and final disposal technology.

As for such new reactors as high-temperature, gas-cooled reactors, the stress was on related basic research and the training of technical personnel to lay a firm foundation for the long-term development of nuclear energy.

7. Development of New Energy Resources

The guiding principles in the development of new energy resources are these: Raise the technical level of simple projects and establish new comprehensive energy demonstration points to meet the domestic and industrial energy requirements in the countryside. In solar energy, there were research projects to develop solar cells, solar water heaters, solar stoves, and solar housing. In biological energy, the emphasis was on the development of new plastic methane generating pits. In wind energy, research concentrated on the development of simple and reliable small and medium-sized windmill generators (from below 100 watts to tens of thousands of watts), which can operate independently. These machines provide electricity to scattered users in remote areas and supply energy for irrigation. Then there were such simple projects as cultivation or aquaculture in greenhouses heated by geothermal energy, the anticorrosion technology of geothermal installations, and the recovery of geothermal water. The 3,000 kW tidal power experimental station at Jiangxia studies technology and equipment related to electricity generation powered by tidal energy, thus familiarizing us with the technology of solving electricity supply problems in coastal areas and on islands.

On the basis of single projects mentioned above, a number of comprehensive energy demonstration projects or villages have been set up, based on rural energy division, to gain experience in the popularization of new energy resources everywhere during the Seventh Five-Year Plan.

In recent years, the scientific and technological drive in the realm of energy has made big strides, reaped a bumper crop of high-standard scientific and technical achievements, and produced significant social and economic results.

A host of scientific and technological achievements have been made in coal mining technology.

As a result of research in oil prospecting technology, we have obtained the basic technology of three-dimensional seismic prospecting, gathered data, and trained a team of workers. These breakthroughs have led to a marked improvement in the precision of prospecting in geologically complex areas and in areas with multiple types of reserves. By March 1985, 101 oil wells, each more than 1,000 meters deep, had been tested, increasing crude oil output by 330,000 tons.

Dozens of scientific and technological achievements have resulted from research on hydropower technology, most of which have been applied directly to engineering projects. There has been a major breakthrough in research on the construction of high earth and rock-fill dams; it has now been proved that the use of weathering materials as impervious barriers in the construction of high dams satisfies design requirements in terms of strength, impermeability, and physical chemical properties. The application of this technology in the Lubuge hydropower project resulted in a saving of over 2 million yuan in investments, opening up a new technical path in the use of local materials in the construction of high earth and rock-fill dams.

Coal gasification research: Several experimental furnaces have been put up, including fixed pressure gasification furnaces and coal-water slurry pressurized furnaces. In addition, experiments were carried out with different kinds of coal under different technical conditions in conjunction with engineering projects around the nation, thereby laying the groundwork for coal gasification in China. As for research on fluidized-bed combustion technology using low-grade coal, we have built a 130 ton/hour fluidized-bed boiler and a 10 ton/hour lignite fluidized-bed boiler, providing technical conditions for the use of low-grade coal and gangue in electricity generation. In the combustion of coal-water slurry, tests were successfully carried out using industrial boilers. In the area of fuel substitution, the performance of M15 methanol gasoline was thoroughly tested on the three major types of motor vehicles in use in China. An extensive test involving 500 trucks was also run, with satisfactory results.

In the development of nuclear energy technology, the design research of centrifuges and low-temperature heat generating reactor have both made important progress as planned.

The scientific and technical drive on the new energy front has paid off economically. Solar energy: The output capacity of the monocrystal silicon solar battery is expected to reach 600 kW by 1986, a six-fold increase over 1980. Prices will drop two-thirds, and the slew reject rate will range from 10 to 12 percent. Marsh gas: A new red-earth methane generating pit has been successfully developed. This kind of methane generating pit can be produced on an industrial scale, requires little cost, and is simple to build. Its output more than doubles that of the cement pit. So far over 50,000 such pits have been built. Wind energy: Six models of small windmill generators and water lifts have been developed. More than 10,000 such machines are now in widespread use and are popular with peasants and herdsmen. Thermal energy utilization: The focus was on the development of technology for the comprehensive utilization of geothermal energy in northern China. A research center for the comprehensive utilization of geothermal energy has been set up. Ocean power generation: Construction has been completed on the Zhejiang Jiangxia Experimental Tidal Power Station with an installed capacity of 3,200 kW and an output of 10 million kWh annually. Its experience will pave the way for the growth of tidal power in China.

Section 4. Raw Materials Industry

Based on national economic needs and the demand of new technologies, and in the light of the special characteristics of the nation's resources, the Sixth Five-Year Plan provided for the following research projects: the development and comprehensive utilization of the three major paragenetic mineral deposits--from Panzhihua, Jinchuan, and Baotou, as well as aluminum, zinc, copper, tungsten, molybdenum, tin, gold, and rare earths in Jiangxi; ore dressing technology of alloy steel, low alloy steel, and iron ore; new building materials, the decomposition of cement outside the kiln, and the development of float glass; the multiple processing and comprehensive utilization of petrochemicals; and new materials research etc. After several years' intensive work, the scientific standard of China's raw materials industry has gone up, contributing to national economic development.

1. Nonferrous Metals

Besides continuing research on the comprehensive utilization of the three major paragenetic mineral deposits--Panzhihua, Baotou, and Jinchuan--we zeroed in on five nonferrous and rare metals with vast national economic significance and revolved our research around existing key technical issues in development and utilization. Meanwhile, we also carried out geological prospecting as appropriate. These were our areas of concentration:

(1) Comprehensive Utilization of Panzhihua Deposits

Panzhihua is one of the world's rare super-large vanadium and titanium bearing magnetite, intergrowing with such elements as cobalt, nickel, chromium and gallium. After years of hard work, iron and steel production has become a fledgling industry. But for years vanadium and titanium resources have not been recovered and utilized properly, resulting in waste and environmental pollution. Accordingly, we made the proper recovery and utilization of vanadium and titanium one of our main focuses during the Sixth Five-Year Plan. Research was done on the geological structural characteristics in the Panxi Rift Valley region and estimates were made of its mineral resources in order to provide a scientific basis for increasing the region's mineral production in the long run.

(2) Comprehensive Utilization of Jinchuan Resources

Jinchuan nickel intergrows with many metals. With its vast reserves and high-grade ores, it is one of the world's rare large-scale nickel deposits. Apart from nickel, there are such intergrown metals as copper, cobalt, the platinum group of metals, gold, silver, and sulfur. However, years of using substandard mining technology has led to heavy mineral losses and severe sulfur dioxide pollution in the processes of extraction, manufacturing, and smelting, thus impeding significant progress in production development.

To double the nickel output of the Jinchuan Company to 20,000 tons annually during the Sixth Five-Year Plan, we must come up with advanced mining technology and a full line of new technology to comprehensively recover cobalt and the platinum group of elements, and new technology to convert sulfur dioxide into sulfuric acid. That way we will also lay the technical foundation for doubling the nickel output to 40,000 tons during the Seventh Five-Year Plan.

(3) Comprehensive Utilization of Baotou Resources

Baotou Baiyun Ebo Mine abounds in useful elements like iron, rare earths, and niobium, but it also contains such harmful foreign matter as fluorine and phosphorus which are extremely detrimental to smelting. Our failure to find a way when the Baoshan Iron and Steel Complex was built to remove fluorine and phosphorus during ore dressing has led to a series of difficulties.

In our research, we zeroed in on ore dressing and thoroughly solved the problems of fluorine pollution, the hazards of phosphorus, and the recovery

and utilization of rare earth. Among the major research projects were those dealing with the smelting of rare earth concentrate, niobium alloy steel, the application of rare earth alloy steels, the improvement of iron and steel quality, and comprehensive environmental protection.

(4) The Development and Comprehensive Utilization of Tungsten, Tin, Molybdenum, Aluminum, Copper, Lead, Zinc, and Gold

China abounds in tungsten, tin, and molybdenum and once exported them in substantial quantities in return for foreign exchange. Nevertheless, exports have languished at the level of the 1950's and 1960's and the country is only capable of exporting placer deposits or primary processed products. Aluminum, copper, lead, and zinc are common nonferrous metals, yet backward technology and equipment had held back production growth. To put an end to this passive situation, we provided for research on tungsten smelting and the manufacturing of tungsten products, the high-temperature chlorination of tin, the VCR mining of aluminum and zinc ores, the technology of large-scale open-pit copper mining, alumina production cycle, and equipment improvements. Other topics were the mineralization conditions for the key minerogenetic regions of nonferrous metals, the methods of locating deposits, and the long-term prospects of locating deposits.

Great progress has been made in all these areas. Concerning the comprehensive utilization of Jinchuan resources, for instance, we have come up with an entire line of new technology, from mining and ore dressing to smelting and the treatment of the three wastes, giving production a brand-new look. By inventing a method to support hazardous rock formations and mechanized mining, we have found the key to the underground treasure chest of Jinchuan. The adoption of a new technology involving high pH value, high current density electrolytic nickel has increased the nickel production capacity using electrolytic troughs by one-third. The smelting recovery rate of nickel has reached 83 percent today, up from 76 percent in 1978. As a result of successful research in extracting cobalt from converter residues and separation and purification of secondary cobalt, the recovery rate of nickel has gone up from the original 30 percent to above 50 percent. Intermediate experiments to extract precious metals from secondary copper nickel alloy, making use of what was produced locally, have succeeded in raising the recovery rate of platinum and palladium from 49 percent to 68 percent and that of osmium, iridium, ruthenium, and rhodium from 1-3 percent to 44 percent. The results of intermediate experiments in nickel-copper concentrate granules have been put to use in the construction of a production workshop with an annual output of 180,000 tons of industrial sulfuric acid. The production of rare earth chloride through the smelting of Baotou's rare earth concentrates is a new technology innovated by China. It can break down waste rock in 15 to 20 minutes, instead of the 6 hours required by the old process. It cuts down energy consumption by two-thirds, waste rock consumption by 25 percent, and costs by 320 to 460 yuan per ton. The success of the experiment in the making of sponge titanium by a method combining Panzhihua reduction and distillation has boosted China's titanium sponge production to the level of developed nations in the late 1970's, saving electricity by 31.5 percent and 250 kilograms of magnesium for every ton of titanium produced, and shortening the production cycle by

20.5 percent. By economizing on electricity and magnesium alone, the new technology has cut the costs of producing 1 ton of titanium sponge by over 10 percent. The Fankou Aluminum-Zinc Mine invented the VCR mining method by following systems engineering. Its achievements included research on a high air pressure, large-diameter deep-hole drilling rig, and accessory accessory equipment; the making of high-density (1.46 grams per cm), rapid (5,833 meters per second) and very powerful special explosives, and the successful experiment of a 2 m^3 remote-control scraper whose performance has matched the most advanced in the world in every way. The technology involved can be transferred as a whole. After adopting the VCR mining method, Fankou mine has posted 40 million yuan in additional profits each year.

2. Dressing Technology of Alloy Steel, Low Alloy Steel, and Iron Ore

Low alloy steel: Research focused on converter top/bottom complex blowing, spray metallurgy, controlled rolling, and welding. As for variety, research was conducted on steel products in the shipbuilding and coal industries, in oil pipelines, boilers and in construction. Alloy steel: Research concentrated on refining outside the furnace, continuous casting, continuous heat treatment, etc. Research on variety targeted existing quality problems in stainless steel, bearing steel, spring steel, alloy structural steel, and high-speed steel, all of which are urgently needed by the national economy. At the same time, there was also research on related technology, ferro-alloy, fire-resistant materials, and rollers, etc.

At present the bulk of the projects have been completed as scheduled; 70 percent of the key projects either have passed technical appraisal or will undergo such appraisal shortly. Specifically:

The Anshan, Wuhan, and Panzhihua Iron and Steel Complexes have produced over 30,000 tons of steel in six varieties. These steel varieties are resistant to atmospheric corrosion and have been used in the manufacture of a wide range of buses and trucks totaling 1,700, all of which have been put into service. Their resistance to corrosion is two to three times that of ordinary carbon steel, thus lengthening from 5 or 6 years to 12 years the interval between overhauls in the case of railroad cars. Using control rolling technology, Wuhan Iron and Steel Complex has produced on a trial basis 2,200 tons of high-strength structural hull steel, made a mobile ocean oil drilling platform, and put together four 12,000-ton container ships, all in compliance with the standards of the ZC Register of Shipping. Tangshan Iron and Steel Complex has rolled 476 tons of large (36 kg/m) U-shaped steel, whose performance satisfies the TH standards of the Federal Republic of Germany. totally. This kind of steel is now in trial use in coal mines. The M high-speed steel-wire, on which Dalian Steel Plant concentrated its research efforts, underwent repeated tests by machine tool factories and was made into drill bits for export. The steel wire products beat similar German and Austrian products in quality and are on a par with Japanese products of an internationally well known brand. To diversify their stainless steel products, Fushun and Taiyuan Iron and Steel Complexes have developed 12 new varieties of ultra-low carbon stainless steel, including one which has a deep

punching capability and is needed in the electronics and light industry, a nonmagnetic stainless steel used in the making of color TV sets, a high-purity ferrite stainless steel used in heat exchangers, and an ultra-low carbon high alloy stainless steel. Working jointly with the units concerned, the Central Iron and Steel Research Institute has developed an atmospheric corrosion-resistant and wear-resistant stainless steel to be used in manufacturing the middle rings in G817 hydraulic turbines and 821 welding materials. Both were successfully applied to the 125,000-kW No 7 generating unit at Erjiang at Gezhouba. After more than a year's operational evaluation and appraisal, the materials were found to perform as well as similar products in the world. Using spray metallurgy technology, the duration of heat is shortened by 20 to 60 minutes and 20 to 100 kWh of electricity are saved for every ton of steel manufactured. The sulfur content in low sulfur pure-steel can be reduced to a low 0.001 percent.

After years of hard work in ore dressing research, we have obtained a number of scientific achievements in processes, equipment, and drugs, some of which have been applied in production with outstanding economic results, providing the technological transformation of the five major iron mines and newly built ore dressing plants with a design basis and bringing China's iron ore dressing technology to an advanced international level.

3. Building Materials Industry

"New building materials research," "the technology and equipment of cement decomposition outside the kiln," and the "technical development of the glass flotation method" were the thrust of the scientific and technological drive in this area.

Decomposition technology of cement outside the kiln: The focus here was to come up with sets of equipment for a production line capable of producing 700 tons of cement daily and the improvement of technology, to apply existing individual research results in conjunction with large imported equipment and technology to design and manufacture a production line with a daily output of 2,000 tons, and to continue the research on related technology and trial manufacture large-scale special equipment to contribute to the effort in the Seventh Five-Year Plan to popularize the 700-ton and 2,000-ton cement decomposition lines.

Flotation production technology: The emphasis here was to build a production line at Luoyang Glass Plant capable of melting 400 tons of glass daily and to transform old lines. This was accompanied by the selective importation and assimilation of necessary accessory technology, materials, and equipment. To increase variety, research was conducted in such new technology as electrically smelted float glass, hollow core glass and other [deep processing] technologies and new float glass components, and new shallow pool smelting research development work.

New building materials: The focus was the development of new wall materials. Four new models of external composite wall boards were developed. They fit different structural systems and have good heat preservation and insulation

properties. Also developed were construction block hollow sintering products. A joint attack on production processes and building technology was launched, resulting in an experimental production line and demonstration projects. In addition, there was research on inlaying, coating, and other indispensable materials.

The three areas of endeavor above have yielded the following results:

We have mastered the entire technology of producing production lines with a daily output of 700 tons, and on that basis, organized demonstration designs and demonstration design seminars, thus laying the foundation for the building of a large number of decomposition lines outside the kiln with a daily output of 700 tons.

Today, a complete decomposition production line with a daily output of 2,000 tons is under construction and is expected to be completed and go into production in 1986. Other related research tasks have also been completed, providing the technical conditions for the extensive development during the Seventh Five-Year Plan of outside-the-kiln cement decomposition production lines each with a daily output of 2,000 tons. Related research concerning fire-resistant materials has yielded nine new varieties in 3 years. During this period, design was completed on 2,000 tons of fire-resistant materials for kiln use. Guidance and assistance was rendered to the fire-resistant material plants in their construction of seven production lines, to be ready for volume production in 1986. The seven production lines can support the construction needs of more than three large decomposition lines annually.

China's first 400-ton floatation method production line went into trial production in May 1985 and has been operating normally so far, with a notable improvement in product quality. The plan is to use this technology to build a dozen or so 400- to 500-ton floatation method production lines.

After 3 years of hard work, we completed the "concrete-rock composite outer wall board" research, from the properties and construction of a single board to experimental construction and trial production. By late 1985, 300 m^2 of experimental construction and 5,000 m^2 of high-rise experimental construction were completed, along with an experimental production line that can produce enough materials for 100,000 square meters of construction each year. A series of material tests were conducted, yielding comprehensive data. Test results prove that the 25 cm thick composite cement-rock sponge external wall board is a better insulator than the 49 cm solid brick wall and can cut down on energy consumption by 20 percent during the heating season.

4. Multiple Processing and Comprehensive Utilization of Petrochemicals

The oil refining industry focused its research during the Sixth Five-Year Plan on the multiple processing of crude oil in order to increase the recovery rate of light oil products and the variety of high-quality products. Accordingly, the catalytic cracking of normal-pressure residual oil, the production by residual oil delayed reforming and other research concerning isomerized catalyst were incorporated into the research plan. As a result, the catalytic

cracking technology for Daqing crude oil pertaining to atmospheric distillation of residual oil has reached an annual output of 120 tons and reached the standard of similar products overseas, producing obvious economic benefits. The leaf-shaped coke made from the thermally cracked residual oil of Daqing crude oil is a match for Japan's leaf-shaped coke by every criterion. The making of 1,400 tons of leaf-shaped coke into graphite-electrode has produced good results, reducing consumption to 5 or 6 kg from 9 to 10 kg per ton of steel had ordinary electrodes been used.

A good deal of progress has been made in heavy oil hydrogenated catalytic cracking agent. A new xylene hydro-isomerized catalyst has been used in production equipment, facilitating output increases in synthetic fiber raw materials.

To make rational use of carbon-4 fraction, a byproduct of ethylene machinery and catalytic cracking machinery, we stressed the development of the production and application of methyl butyl ether and improved the technological standard of making butadiene via butene dehydrogenization. To make use of carbon-5 fraction, a byproduct of the ethylene equipment, research was done on the separation of isoamyl diene, intermediate pentadiene and cyclopentadiene, which formed the basis for technology to make a series of fine industrial chemicals. Alkene polymerization: After absorbing and assimilating imported technology, we focused on new polyacrylic technology to pave the way for the construction of large-scale projects and the rational utilization of propene resources in the future. To expedite technical progress in the modern petrochemical industry, we also stepped up research on various petrochemical catalysts and carriers.

After years of effort, many of the above projects have produced results. For instance, methyl butyl ether passed appraisal at the ministerial level in June 1984. After a 2-year trial run on semi-industrial experimental machinery with an annual output of 5,500 tons, the resultant catalyst has reached advanced international level, laying the groundwork for building industrial machinery with an annual output of 20,000 tons. The development of C5 separation technology has by and large been completed. Equipment in intermediate experiments has been operating for almost 1,000 hours. Both product quality and recovery rate fully satisfied contract requirements and attained the standards of similar foreign products. Polypropylene technology of the 1,000-ton level, which uses smelter gas as raw material, passed appraisal at the ministerial level in May 1985. It met all contract criteria when applied to production equipment with an annual output of 2,000 tons. The process is simple, investments small, operating costs low, pollution limited, and economic results striking. It is well suited to the comprehensive utilization by small and medium-sized enterprises of scattered propylene resources. Research on various other catalysts is also proceeding well.

Research on feed and food additives, vitamins, special resin and paints, dyes and dyeing and printing auxiliaries--the centerpiece of technological development in fine industrial chemicals--has paid off handsomely. Take dyes and dyeing and printing auxiliaries, for instance. Altogether, 91 new varieties were developed, of which 58 have been put into production. In addition, the

manufacturing processes of eight traditional varieties were transformed to improve product quality, of which two have been put into production. Projections are that when the project is completed and output reaches the planned target, output value may amount to 300 million yuan annually, with profits and taxes hitting 100 million. Not only will it generate significant economic benefits, but it will also duly contribute to satisfying the color demands of the textile market and enriching people's lives.

The development of chemical building materials and the replacement of wood and steel by plastics were also among the key research projects tackled. Resin: Modifications, such as filling, mixing, strengthening, and copolymerization, were made to such common plastics as PVC and polyalkene, thus increasing resin variety to satisfy the demands of different construction uses for plastics with different properties. As for the variety of manufactured products, emphasis was on water pipes, sewers, doors, windows, flooring, water-proof rolled materials and coatings, binding agents, sealing materials, and insulating materials. Following years of intensive research, the technology of PVC sewers has been completed. Sewer materials and parts now by and large form a complete set. We can already produce 8,000 tons a year, enough to serve the construction needs of 15 million square meters of residential housing. Even if we just look at the 900 million square meters of housing already built, the use of PVC has saved 30,000 tons of cast iron and lowered costs by 2 million yuan. The trial manufacture of PVC water pipes has also been a success story and we are now working on their production. Considerable headway has also been made in the production technology of plastic doors and windows suited to different regions, their performance matching or approaching that of their American and Japanese counterparts. Breakthroughs in the production of low-grade and upscale water-proof materials and successes in the development of related construction paints and binding agents will all expedite the widespread use of chemical materials in construction.

Section 5. Communications and Transportation

Three major research areas were identified: long-distance pipeline transport of coal, an entire line of heavy rail freight technology, and port construction and loading technology. Altogether, eight research projects were undertaken in these three areas.

1. Long-Distance Pipeline Transport of Coal

Slurry pipeline transmission of coal is a new technology in coal transportation.

This project was based on a feasibility study conducted in 1980-82 on coal pipeline transportation and basic laboratory research. Its purpose was to provide China's coal pipeline development with the technology and equipment in coal liquefaction, pumping, and dehydration. The target was to meet the ETSI pipeline equipment standards (including those in performance, service life, and control technology) set by the U.S. Department of Energy. Another part of the project was to study the coal varieties that were candidates for

this mode of transport, their flow deformation, and the fundamental parameter of pipeline transport. The Tangshan Experimental Center for the Pipeline Transport of Coal has now been completed and been checked and accepted by the government. Its standard equals that of similar laboratories in the world. Also completed is research on the kinds of coal to be thus transported, which are now being used in feasibility studies. Construction of the main pump and main valve laboratory at Plant 523 under the Ministry of Nuclear Industry has been completed in large part. The pump and valve development plan has been verified and approved at the ministerial level. Luoyang Mining Machinery Plant has imported technology on the centrifugal filtering and dehydration of liquefied coal and has put it into production.

2. Research on the Entire Line of Heavy Rail Transport Technology

The purpose of this piece of research was to increase the train drawing factor on the country's main lines of rail communication from 3,500 tons to 5,000 tons as a way of substantially expanding China's rail freight capacity.

Accordingly, the railroad system decided on these eight research projects: 6,400 kW 8-axle electric freight locomotive; 3,160 kW diesel locomotive, 1,470 kW diesel switch engine (East Wind 7), a new open freight car capable of transporting 60 tons of coal, experiments on an entire line of double-track technology of 60 kg per meter, braking equipment and technology for heavy freight trains, electricity supply methods, and communications technology for electric trains.

To ensure heavy freight trains are loaded in coal mine areas and to develop land-and-sea coordinated transport services, research was also conducted on coal loading and unloading technology and equipment at mines and harbors.

The trial manufacture of the 6,400 kW 8-axle electric locomotive has been a success. The locomotive is now being tested for its traction capability. Also successful was the trial manufacture of the 3,160 kW diesel locomotive (16 V 280), which has in addition completed the traction operation test. The 1,470 kW diesel switch engine has passed appraisal and is now in the stage of small batch production. The new 60-ton open coal car has been successfully trial manufactured and is now in production. It has been decided to use the 60 kg per meter double tracking technology on the entire line between Datong and Qinhuangdao. Traction and braking research on 5,000-10,000 ton trains have been a success. On a train moving at a speed of 80 km per hour, the braking distance has reached China's railroad requirements. Heavy coal trains between 5,000 and 6,000 tons have made successful trial runs on the Datong-Qinhuangdao line.

Applying systems engineering methods to the optimization studies of the sea transport of coal, the Ministry of Communications has worked out an overall plan for setting up a sea transport system for coal with a total capacity of 11 million tons, thus providing China's energy transportation with a scientific basis. This systematic optimal plan costs 400 million yuan less in initial investments than the original plan. After it is implemented, it can reduce total transportation costs by 100 million yuan each year. Meanwhile,

coal loading and unloading equipment has been invented for the ports concerned, providing key technology to limit the draft even for a large vessel and to equip a vessel to load automatically. Phases 1 and 2 of the coal pier project at Qinhuangdao have been completed.

The achievements of this entire line of heavy rail transport technology have been adopted by the Datong-Qinhuangdao rail construction and upgrading project and will be extensively used by other transformation projects on the country's main railroads.

3. Port Construction and Loading Technology

The shortage of deep-water berths at ports, backward loading processes and equipment, bottlenecks in the transportation system, and restrictions imposed by the transportation management system largely explain why long queues of ships have formed at Chinese ports and why goods have been piling up on the docks waiting to be loaded. To bring this situation to an end quickly, it is the aim of port construction and loading technology to provide new technology, equipment, and processes so that port construction is accelerated, its construction costs are lowered, and port loading capacity is boosted. Hence the emphasis on "soft-base" handling technology, large initial stress concrete piling technology, containerized transport, loading, unloading and transportation equipment, large-scale grain unloading equipment, and highway and port transportation technology.

At present, research on vacuum pre-pressed "soft-base" technology has been completed, providing a complete line of technology for "soft-base" processing that can be used year round. Compared to traditional pre-pressed methods, this new process takes one-third less time and one-third less energy and lowers transportation expenses by one-fourth. It is being used extensively in port construction projects. Research on the technology of large concrete pre-stressed tubular pilings, formed pilings, and sunken pilings, all with a diameter of 1.2 meters, has been successfully concluded. They are now in trial use at certain docks and will be ready for popularization during the Seventh Five-Year Plan. Turning to containerized transport technology, there has been successful research on such technology and equipment as large-span unloading bridge direct containerized transport and container collection, distribution, and transportation system with an annual handling capacity of 100,000 containers. As for the system of unloading technology, a large transporter, a conveyor system and computerized unloading system, and an automatic control and centralized computerized management of the unloading system have been successfully developed and installed for use at Zhanjiang harbor.

Section 6. Machine Industry

There were two major research areas with a total of nine research topics:

1. Basic Technological Research in the Machine Industry

Basic components research, mainly microwave semiconductor components, vacuum components, photoelectric components and indicators, machine tool electrical

equipment, low-voltage electric appliances, hydraulic and pneumatic components, packing materials, precision gears for bearing and heavy-duty machine tools, etc. Product quality was improved and variety was increased.

Basic machine research focused on the development of numerically controlled machine tools and precision processing, high-precision machine tools and heavy-duty and ultra-heavy-duty machine tools, high-precision high-efficiency forging press and key technology and precision casting machines and key technology.

Processes, materials, and key basic technological research: Focus was on new processes that require little forging and no cutting, new process of heat treatment and related equipment, instruments and meters, engineering plastics, composite materials applications technology, lubricating oils, and solution-resistant compressing oil.

Research on testing equipment and instruments concentrated on high-purity signal generators, standardized spectral analysis instrument, 500 MHz wide-band oscillograph, nondestructive testing and dynamic balancer, large precision meters, etc.

2. Development of Complete Sets of Large-Scale Equipment

The purpose of research was to develop large, highly efficient coal mining equipment and metallurgical installations, to perfect the 300,000 kW Chinese-made thermal generating set, and to absorb and assimilate the technology of the imported 300,000 or 600,000 kW generating units. Breakthroughs have been achieved in the technology of ultra-high voltage alternating current electricity transmission and transformation equipment, direct current transmission equipment and technology, high-head large capacity hydropower facilities, and in expanding the reception area of TV broadcasting.

All these projects have achieved good results and paid off economically in significant ways.

Basic components: A host of world-class standard products have been developed, such as the current-transfer ration valve, spill valve, etc. Research to reduce the noise of hydraulic components has also been remarkably successful; the noise level of the Model CY 25 plunger pump has been brought down to 70-75 decibels from the original 80 decibels, Model YB 1025 vane pump, to 69-70 decibels, which was in compliance with Japan's JIS standards. As for bearings, research was carried out in the production technology of Grade 1 raising the material utilization rate by 10 percent.

Basic machines: A batch of high-grade, precision and advanced products have been developed, e.g., the JCS-FMC and JCS-FMC_2 flexible manufacturing units (both vertical and horizontal) can be incorporated into the flexible manufacturing system for continuous operation without supervision. This is the standard of the early 1980's in the world. Another example is the J92K-40T numerically controlled die rotary compressor, the first high-precision computerized all-purpose automatic forging press made by China. That machine

has a high degree of machining accuracy, performs well consistently, and approaches the standard of similar products by AMDA Company of Japan. Production efficiency has been improved 4- to 20-fold while the price of the entire machine is half that of imports.

Research on processes, materials, and basic technology has resulted in improvements in the quality of complete sets of large-scale equipment and key machine products and lengthened service life. In research on the stainless steel turbine vanes at the Gezhouba project, the large 40-ton assembly was thoroughly studied, 4,000 samples were analyzed, and almost 20,000 pieces of data were collected, the law of functional decline was clearly understood. As a result, the performance of the large cross-section of the stainless steel vane was substantially improved and it was put to use in the Dajiang power station project. Through research, we have mastered such new processes or technologies involving casting, low-stress, high-intensity thin wall casting, microcomputerized plasma welding, and nonpolluting thiocyanic codoping, among others. Grey cast iron discharge ducts are being produced on a large scale. Road tests showed that their service life is 80,000 to 100,000 km, compared to 10,000 to 20,000 km for its original grey iron counterpart. This is on a par with the world's most advanced equipment. As a result of research on the optimal technical parameter in optical cold processing, we have found a way to the systematic optimal matching of the various technical parameters of optical lenses, thus transforming the backward look of China's optical cold processing and bringing it up to the international standard of the early 1980's. In the wake of industrial production tests using the camera, film making equipment, and microscopic lens, its production efficiency has increased 3.5- to 4.5-fold, the primary passing percentage rising to over 90, compared to 30 to 50 percent for the old process. It has now been formally put into production.

Basic technical research has resulted in a number of key technologies of general applicability, boosting our effort to raise the product design standard.

Development of complete sets of large-scale equipment: Equipment for a large open-cast mine capable of turning out 10 million tons annually; the 320,000-kW hydropower generating set at Longyangxia; the 500-kv transmission and transformation equipment for Jinjing line alternating current; and the Dongfeng 300,000-kW thermal generator set. Other accomplishments by late 1985 were the 100,000-volt direct current transmission and transformation equipment at Zhoushantu, the perfection of 100,000 to 300,000 kW Chinese-made thermal power generating set, and the 300,000 kW thermal power testing unit. Of these, the main technical parameter of the Jinjing electricity transmission equipment has complied with IEC standards and been put into service. Equipment for a large open-cast mine with an annual output of 10 million tons included KY-250A high platform gear drilling machine, a 10-cubic-meter excavator, and a 100-ton electric self-loading car. After trial runs at a mine, the equipment is now being produced in small batches. The 320,000 kW hydropower generating set at Longyangxia has a wheel with a diameter of 6.2 meters. With a peak flow at 150 meters and a thrust bearing load of 2,270 tons, it is the largest mixed-flow hydropower generating set in China today. Judged by all major economic criteria, it has reached the standard of similar advanced products overseas.

Section 7. Social Development

1. Prevention and Treatment of Cancer and Viral Hepatitis and the Development of New Chinese and Western Drugs

The thrust of research was directed at esophageal cancer, liver cancer, nasopharyngeal cancer, stomach cancer, and lung cancer--all diseases that seriously threaten human health and life and whose prevention we already know something about. A good deal of progress has been made in our attack on these five forms of cancer in terms of epidemiology, factors for occurrence, diagnosis, treatment, and drugs.

Esophageal cancer: Through research on fungi, nitrosamine pathogeny, and preventive experiments, we have come to understand the synergetic carcinogenic effects of molded food and the role of certain vitamins (e.g., Vitamin C) and some trace elements in blocking the formation of nitrosamine in the human body. This discovery provides the prevention of esophageal cancer Class 1 with a theoretical basis and practical experience. Liver cancer: Research has centered on the relations between liver cancer pathogenesis and Hepatitis B viral infection, on the one hand, and food contaminated by flavacol and drinking water containing selenium, a pathogen, on the other. Research isolating the liver cancer cell in humans identified, for the first time in the world, N-ras as the transforming cell in primary liver cancer and liver cancer branch 7402 and proved that N-ras is a major cancer-causing cell as far as primary liver cancer in humans is concerned. These findings laid a solid foundation for future research in the principles of cancer transformation and the functional mechanisms of the Hepatitis B virus and chemical carcinogens. Nasopharyngeal cancer: Research focused on the EB virus, the relations between other agents and nasopharyngeal, and early diagnosis methods. The development of the early diagnosis method for nasopharyngeal cancer (ELISA process) has improved the accuracy rate of diagnosis. This technology is advanced by international standards. Stomach cancer: Research pointed to a link between stomach cancer and diets that are low in protein and contain little fresh fruits and vegetables. From research on stomach cancer-related antigens, we identified the hybrid tumorous cell, a tool that will be useful to basic research and diagnosis and treatment. Lung cancer: Research focused on causes, related antigens, and the transformation mechanisms of the disease. Quantitative studies on the danger of smoking and air pollution as causes of lung cancer and research on other agents have provided us with a preliminary basis and experience for instituting urban environmental health monitoring as a way of controlling and lowering the incidence of lung cancer and setting up a lung cancer prevention and treatment network. Research on lung-cancer-related antigens has paved the way for clinical practice. Basic cancer research: The stress was on the isolation and identification of cancerous cells, the growth, division, and modulation of malignant tumors, the infiltration and metastasis of cancerous cells, and the immunoregulation of malignant tumors. Progress has been made to various extents in these areas of research.

The use of photosensitive therapies to diagnose and treat cancer has become a fledgling technology in the world in recent years. During the Sixth Five-Year

Plan, China made photosensitive drugs, laser equipment, clinical practice, and basic research its priorities and has had considerable achievements. Its photosensitive drugs are as good as the most advanced in the world.

Viral hepatitis: In the main, what China did on this front was to incorporate into the list of key research projects to be tackled the development of a Hepatitis B vaccine and genetic engineering vaccine, the transmission of the disease from mother to child, and methods of blocking this transmission.

The development of a vaccine made from blood for Hepatitis B has ended its experimental production stage. Now the vaccine is being produced in volume. It is estimated that by 1986 enough will be produced to supply the needs of 6 million people, the second largest output in the world. Both its quality and immunization effectiveness match the best in the world. The expression of Virus B vaccine made from genetic engineering with yeast and the cells of mammals is almost good enough to put it among the advanced internationally.

Traditional Chinese medicine is unique to this country. Ginseng, pseudo-ginseng, artificially bred musk, round cardamon, betel palm, and the peeled root of herbaceous peony were selected for inclusion in the list of research projects. Moreover, to produce a new generation of antibiotics in the nation, B-lactim semi-synthetic antibiotics was made part of the research drive.

Ginseng research: We concentrated on ginseng cultivation on farmland and in traditional ginseng grounds, the technology of growing high-quality, high-yield ginseng, the prevention of root diseases affecting ginseng, and the processing of red ginseng and its quality standards. This gave us a preliminary understanding of the technology of growing ginseng in fields and in the more traditional terrain, the comprehensiveness of the technology involved, including such interrelated measures as water, fertilizers, soil, and illumination, and the comprehensive measures to prevent and treat root diseases. That way we were able to make significant gains in the quality, yield, and unit weight of ginseng. Research on the technology of processing red ginseng shed light on the qualitative differences between Chinese red ginseng and its Korean counterpart, thus laying a sound foundation for changing the status of Chinese ginseng in the international market. As for pseudo-ginseng research, we targeted the analysis of its active components and the clinical applications of various new preparations in order to have more new varieties available for export in the future.

Research on artificial breeding of musk: Here further improvements were made to breeding technology, the techniques of musk extraction, and disease prevention. These improvements will gradually make the artificial breeding of musk for its fragrance a viable alternative to hunting and killing wild river deer.

To develop a new generation of antibiotics for the nation, we also provided for research to develop B-lactim semi-synthetic antibiotics and to improve the manufacturing process of 6 APA, a selectively bred variety of penicillin. We also worked on the fermenting, extraction, and splitting of Cephalosporin C.

Rapid progress has been made in the new cephalosporin and the development of oral cephalosporin TV; HR-756 and cephalosporin (T-1551) have passed muster with the appraisers. Their quality equals that of similar products in the world.

2. Research on Family Planning and Contraceptive Methods and Devices

To achieve the strategic objective of curbing China's population to 1.2 billion by the end of the century, average annual population growth rate must be limited to below 0.95 percent. Each year we must provide 340 million men and women in the reproductive age with safe, convenient, economical, effective, and practical contraceptives, birth control drugs, and devices. During the Sixth Five-Year Plan, the emphasis was on research to improve the effectiveness of the intrauterine device and study the mechanisms whereby the IUD causes bleeding. Permanent contraceptives for men and women and drugs to terminate pregnancy or prevent premature birth were also studied.

3. Comprehensive Technology To Protect the Environment and Prevent Pollution

The objective of environmental protection work is to arrest the trend toward continuing environmental deterioration in China. In accordance with the principles of "combining prevention with treatment, while emphasizing the former, combining the long-term with the short-term, but stressing the latter, and bringing the situation under control gradually," we succeeded in mastering the comprehensive approach toward tackling environmental problems in the Beijing-Tianjin region and pollution in Huangpu Jiang. We also came to understand the environmental ecological system in Taihu, its environmental background value, and its environmental capacity. All this research provides China's effort to prevent environmental pollution with scientific methods and a scientific basis. We have come up with a host of achievements. For example, comprehensive environmental research in the Beijing-Tianjin region and Bohai, Lanzhou University's antipollution plan, and the comprehensive environmental evaluation in Beijing's western suburbs have yielded reliable data for land management and economic planning.

Section 8. Tackling Key Projects in the Seventh Five-Year Plan

The government's science and technology drive during the Seventh Five-Year Plan rests on long-range planning and dovetails with that in the Sixth Five-Year Plan. Substantively, the effort covers four areas:

1. Major Technology and Equipment for Developing the Economy

Agriculture: We will stress seed research and food changes to push for a new generation of varieties in such essential crops as grain, cotton, and oil-bearing crops, improve quality and disease-resistance, and increase output by more than 10 percent. Food transformation will consist mainly of the development of feed protein and related feed, animal husbandry, poultry, and the breeding of fish, shrimp, and other forms of aquaculture.

Industry: The general demand is to catch up with foreign standards of the 1980's. We must combine research with the absorption and assimilation of mature technology imported from abroad in order to provide key projects and technological transformation with the necessary technology and equipment. The first area concerns the absorption and assimilation of major imported technology. The emphasis here will be on the development of a multichannel seismograph, the three-dimensional simulation of underground gas reserves, and the improvement of the complexity and accuracy of data processing, the development and perfection of six coal excavators, and 11 major complete sets of 300,000 to 600,000 kW thermal generating equipment. The second category consists mostly of technologies developed by China itself. Only key technology and equipment will be imported, e.g., compound blowing smelting technology. The third area will be technology developed by China itself, such as centrifuging isotopes, new aluminum smelting technology, and the science and technology of the Three Gorges key water control project.

2. Development of New Key Products

The development of new key products is targeted with the demands of both domestic and foreign markets. Essentially this means the processing and upgrading of light industrial, textile, and agricultural products, the multiple processing of metals and industrial chemicals, and the development of backward products. For example, the development of multiple processing technology for agricultural byproducts; the breeding of new varieties for aquaculture; the development of new modified chemical fiber varieties; research on medium- and high-priced lubricating oil products; and the development of such fine chemical industrial products as new pesticides, engineering plastics, alloy steel, low alloy steel, new dyes, promoters, and surface active agents.

3. The Domain of High Technology

The leaders of high technology are microelectronics and information technology. During the Seventh Five-Year Plan, the focus in integrated circuit will be on an ultra-microprocessing technology and CAD, CAM, and CAT technology. Other focuses are the 256K integrated circuit; preliminary studies on the 1M bit integrated circuit; the production of the 16-bit digital microcomputer; the development of the 32-bit microcomputer, 400 million disk drives, and the second-generation optical disks; the practical application of optical fiber communication system; and the domestic production of the program-controlled digital exchange. Also stressed will be carbon fiber composites and high temperature ceramics. In bioengineering, we will focus on converting a number of research achievements into new products, e.g., microbiological protein, active dried yeast, Hepatitis B vaccine, etc. In addition, research on gene, enzyme, cell, and fermentation will be intensified.

4. Social Development

The social aspects of scientific and technological work, such as resources, the ecology, the environment, medicine and public health, will be strengthened

in appropriate ways during the Seventh Five-Year Plan. In geological resource research, the emphasis will be on the theory, technology, and methods of oil and gas deposits. Essentially, we will study non-anticlinal oil and gas deposits, the formation of coal gas from Permian coal series, and marine carbonatite facies oil and gas deposits. As far as metals are concerned, the stress will be on nonferrous metals. Efforts will be made to develop prospecting technology for hidden resources and identify successor resource bases in Xinjiang. Turning to land resource research, we will concentrate on biological measures, restore vegetation, and apply comprehensive technology to deal with the Huangtu plateau suffering from soil erosion. In environmental protection, we will take measures to prevent and solve air and water pollution and use technology to turn urban sewage into resources. In medicine and public health, we will zero in on the prevention and treatment of major diseases, the development of appropriate drugs, family planning, better parenthood, and the development of traditional Chinese medicine.

The guiding principle of the scientific and technological drive of the Seventh Five-Year Plan is to provide new technology, new products, and new equipment in order to turn the economy around. We will make every effort to ensure that it is consistent with the demands of economic development and strive for practical results.

12581/6091
CSO: 4008/7

CHAPTER 3. RESEARCH IN THE FIELD OF NATURAL SCIENCES

[Text] The main task of research in the natural sciences is to understand and transform nature. Giving importance to developing natural science research has important significance whether it is for building a modernized material culture or for building a modernized spiritual culture. The challenge of the new technological revolution in the modern world and the urgent needs of the domestic four modernizations constantly place new demands on basic and applied research in the natural sciences and promoting this research constantly opens up new territories and climbs new heights.

Since the founding of the People's Republic of China, China's broad scientific and technical corps has done a great deal of work in all areas of natural sciences research and secured very big achievements.

1. Opening Up, Establishing, and Developing New Scientific Areas Has Secured Theoretical Achievements of Advanced Levels

Due to the interpenetration of various scientific disciplines and the mutual promotion between their research, modern science and technology is constantly producing new sciences. The formation and rapid development within China of nuclear technology, space technology, computer technology, radio technology, automation technology and such technical areas as fiber optics communications, remote sensing, super-conductivity, and biological technology have promoted the development of many new sciences such as microelectronics, bio-engineering, information science, materials science, environmental science, and marine engineering, and the development of these sciences has placed higher and higher demands on new technologies and promoted and guided the increase in new technological levels.

In 1965, China's science workers combined efforts in work on a key problem and after more than 6 years of unremitting effort they synthesized bovine insulin, which was the first synthesized protein in the world marking a giant step forward in mankind's journey to explore the mysteries of life. After this, approximately 150 science workers from 6 units worked for 13 years and in 1981 synthesized yeast alanine transfer RNA showing that the level of China's research on synthesizing nucleic acid is in the advanced world ranks. This research spurred on the development of nucleic acid chemistry, nucleic acid reagents and nuclease and promoted the production and application of many nucleotide pharmaceuticals. Ligand field theory is an important basic

theory in molecular structures. China's science workers have been carrying out systematic research on the forward edge of this topic for nearly 20 years and have made some outstanding contributions and our research work has always been at advanced levels. The anti-Sigma negative hyperion in nuclear physics is an antiparticle of a charged baryon which was first discovered by China and is an important advance in basic particle research. The Goldbach conjecture is a difficult topic unresolved after more than 100 years, but China's science workers have worked hard and have obtained the best current research results in the world. China is also in the front ranks in the world in research work on haploid breeding and tissue culture. In research on crystal defects, China was also the first internationally to realize the polysynthetic polydomain frequency multiplication enhancement effect which improved laser frequency multiplication enhancement effect 10-fold and created a new way to utilize defects in functional materials. China was the first to isolate and cultivate Trachoma Chlamydiales which stimulated trachoma research work on a worldwide scale and earn the "Trachoma Gold Medal" from the International Trachoma Prevention Society. In addition, the first ape-man skull and the first Ramapithecus skull fossils in the world were found in Yunan, China.

2. Emphasizing Basic Research Which Has Prospects for Application and Applied Research Which Can Attain Major Benefits Has Promoted Economic Construction

A great deal of alluvial silt deposits in the Huang He create a serious threat to the vast North China plain. China's science workers have established that the primary source of the alluvial deposits in the lower reaches of the Huang He is coarse sand with diameters greater than 0.05 mm, and if we first concentrate on controlling the 100,000-square-kilometer area in the middle reaches of the Huang He where the coarse sand originates, i.e., control 80 percent of the coarse silt, and this is recognized as an important breakthrough in controlling the Huang He. The East Asian migratory locust is a major agricultural pest in East and Southeast Asia. The proposals for basic control of the locust which have been produced from China's basic research in many areas with regard to the locust has made it possible for China to basically control locust damage. In the early seventies, China's agricultural scientists and technicians discovered and utilized male sterile wild rice to implement successfully the "sanxi" peitao [6792 1152] and was the first country in the world to use "hybrid paddy rice" in large area production. Since it was put into use in 1976, the cumulative planted area has reached 640 million mu, annual production has increased to over 60 billion jin and China's first agricultural science and technology patent has been transferred to the United States. Research on the geology, geochemistry, and the regularity of ore-formation of the granite in South China have obtained results of international advanced levels and directly provided guiding scientific basis for effective exploration and development of mineral product resources. On the basis of research on electric welding arc mechanisms, China's welding specialists have provided new methods of controlling electric welding arcs, breaking through the traditional scope of current electric welding arc control methods, and can automatically carry out optimized welding, and has exported the technology to Sweden. Foreign evaluations say: "China has

entered the ranks of the advanced countries in terms of software unexpectedly fast." China's geological workers have applied new structure theory to find underground water resources and found water for over 200 areas lacking water in China's dozen provinces and municipalities locating 500 wells with a success rate of 80 percent, and have made a contribution to resolving the water supply problem for local production, national defense construction, and daily life. A new type of antimalarial medicine--qinghaosu [7230 5548 4790]--was uncovered in the Chinese medicine qinghao and is considered a breakthrough in the history of antimalarial research. The immunity performance of the mildly toxic lapinized hog cholera vaccine successfully developed by China is in first place in the world and has been adopted widely abroad making a contribution to controlling and eliminating hog cholera in the countries of Europe and Africa. Calculation methods and program research of China's mathematics workers creatively applying mathematics, dynamics methods and computer technology to the mixture mechamisms of the internal combustion engine have improved the level of design of internal combustion engine mixture mechanisms and have been applied in many internal combustion engine plants in China with good economic results. Research on artificial reproduction, phyto population biology and ecology of the sidajiayu [0934 1129 1367 7625] and such theoretical results as impeller mechanical ternary flow theory and shallow sea acoustical research have all been applied in production and earned excellent economic benefits. In materials science, research on low carbon martensite has achieved breakthroughs in design, materials selection and materials usage habits, established a series of new academic viewpoints, and the results of approximately 50 projects have been put into use by many industrial departments. On the basis of 1983 year-end statistics, the economic benefits secured exceeded 150 million yuan, with annual economic benefits reaching 34 million yuan.

3. Promote the Development of Industrial Departments With a Foundation in the New Technology, Accelerate National Defense Modernization Construction

China's successful testing of atomic bombs, hydrogen bombs, and intercontinental ballistic missiles, the launch and recovery of earth satellites, the successful testing of experimental communications satellites and microwave measurement and control systems, the construction of the bridge over the Chang Jiang at Nanjing and the second and third streams engineering projects at Gezhouba, and the successful development of the 100 million instructions per second Galaxy Computer, the 1 million instructions per second vector computer and the super large-scale integrated circuit indicate that China's science and technology has achieved a new level and that national defense industries and industrial departments with the new technology as their foundation have developed rapidly and including the major contribution made by a great deal of basic research work.

The approval in 1985 at the national level of interferon gene engineering indicated that China's gene engineering technology had achieved advanced levels. Biomedical engineering technology has also been widely applied in disease prevention and treatment, and major accomplishments have been achieved in the prevention and treatment of such diseases as hepatitis, chuxuere [0427 5877 3583], and tumors. The 16K static memory (circuit

integration of 18,000 components, equivalent to the degree of integration of a 64K dynamic memory) has been successfully developed. Remote sensing technology has been applied to land resources, regional planning, and resource surveying, the use of computer-laser Chinese character layout systems and laser communication systems and the broad application of computer software in a variety of areas, the successful development of synthetic rubber, silicon-fluorine materials, and various new materials has promoted the development of new technological industries.

It is only on the foundation of just such research work as this, that China has been able to develop these important national defense technologies and many industrial departments which are based on the new technologies. These researches have important significance for digesting and absorbing advanced technology, using new technology to transform the existing economy and to modernize China's industrial structure.

4. To Provide a Scientific Basis for Major State Policies

After practical testing in China's western regions, the theory concerning depressed zone oil formation and the deductions and theories on earth sciences put forth by China's geologists denied the theories of some foreign scholars concerning China's lack of oil. It played an active role in guiding the search for China's oil resources, including the discovery of the Dazhai Oil Field. Beginning in 1955 petroleum geological surveys and geophysical exploration was launched on a nationwide basis and on the basis of the knowledge of these petroleum geology conditions, the Central Committee decided in 1958 to make a strategic shift in the emphasis on petroleum survey and exploration from the western regions to the eastern regions. Geological, physical exploration and test drilling work was launched even more comprehensively in the Song-Liao Plain, and after a great battle and further exploration, it was determined that this was one of the world's big oil fields.

China's scientific and technological workers carried out resource and socio-economic surveys in Xinjiang, using systematic engineering methods they completed a macro-strategic inquiry research for Xinjiang's long-range socio-economic development plan, providing strategic targets for Xinjiang for the end of this century, envisioning the long-range prospects for development in the 21st century, and exploring some of the potential problems that need to be considered. The Xinjiang Autonomous Region Party and government leaders feel that it conforms to the actual situation in Xinjiang and will be the basis for the calculations of the long-range plan to be formulated by the autonomous region.

In such areas as transformation of areas of medium and low agricultural output, rational development and use of water resources, desert reclamation, protection of Sichuan vegetation, development of nuclear technology, energy models, food output forecasting, and marine development, science workers have applied systematic engineering and modernized management techniques and provided a scientific basis for national economic development policy.

5. Large-Scale Comprehensive Scientific Investigations Carried Out on China's Natural Resources and Natural Conditions Have Provided Comprehensive Basic Materials and Development Schemes for National Economic Development

China has compiled four large map collections--national general maps, natural maps, agricultural maps, and historical maps--and has also compiled a geological map of China. These map collections provided important basic materials for national economic construction and national defense construction. China organized science workers to carry out a comprehensive investigation of the South Pole and accumulated a great deal of basic material on Antarctica.

In terms of crop variety resources, China has collected nearly 30,000 agricultural crop variety resources. China has abundant variety resources of wheat: science workers have carried out systematic phytotaxonomic and botanical tissue evaluations of 5,000 local varieties from China's 2,000 counties, and discovered China's special "Yunnan wheat" sub-species and many special new varieties which has reference value for China's wheat breeding and cultivation research.

In terms of agricultural resources surveys and division of agriculture into districts, we have formulated a national comprehensive agricultural districting plan which proposed production distribution, measures to increase production, and paths of development for different regions and on this basis formulated China's forestry districting and animal husbandry districting plans and put forth views on readjusting structure and distribution and establishing commodity bases.

China's science and technology workers have carried out rather systematic investigations and researches on China's Qinghai-Tibetan plateau, the loess plain, Xinjiang, the Heilongjiang valley, the South China tropical region, and deserts, streams, permafrost, lakes, marshes, grasslands, wastelands, forests, salt lakes, and seas and have compiled and published maps, collections, and tables which have provided comprehensive basic materials and development schemes for land reorganization, regional planning, ecological and environmental protection, rational development and utilization of resources, industrial and agricultural distribution and the reorganization of the production structure.

6. The Combination of Basic Research and Applied Research With Training Personnel Has Both Produced Results and Trained Personnel

In institutions of higher learning and research agencies responsible for training graduate students, the two missions of training high level specialists and developing science and technology culture are carried out in close coordination and are complementary. Basic research and applied research are both the foundation of training graduate students as well as an important link in training university students. At the same time, graduate students are an important new force in carrying out basic research and applied research, producing both results and trained personnel. Since China implemented the academic degree system in 1978, 25,757 persons have

become graduate students and of this number, 157 have PhD's and 25,600 have MA's. There are 87,000 persons currently in graduate school, of which 3,000 persons are doctoral students, and 84,000 are MA candidates. Many graduate students have made achievements in scientific research work under the guidance of a professor. The "Design Principles and Method of the Shaqiu Zhuwo [3097 8002 7465 3260] Flame Stabilizer" which was researched by a graduate student at Beijing Aeronautical College under the guidance of a professor, was a major breakthrough in theory and technique, and earned a first class national invention prize. A Nanjing University graduate student combined econometrics and optimization method and using linear programming as a mathematical method, proposed a "Chinese Textile System Programming Model" which has definite reference value for formulating the Seventh Five-Year Plan, and its results basically conformed to economic reality. In addition, there are many graduate students who, under the guidance of their professors, in developing successfully such advanced level scientific research results as arginine sulfate crystals, specially large hole ion exchange resin, mishan yunwenban [1378 2694 0061 4773 3652], and composite silicon nitride ceramic knives have made definite contributions. Taking the 500 results developed by higher schools under the original Ministry of Education as an example, most of the research topics were combined with teaching and many graduate students and graduating undergraduates participated in the research work, nearly one-half of the research results directly supplemented teaching content, produced new teaching materials, and carried out new experiments.

8226/6091
CSO: 4008/7

CHAPTER 4. DEVELOPMENT OF HIGH TECHNOLOGY

[Text] The new technological revolution which is currently under way throughout the world is causing profound changes in international economic and social life. Many of the developed countries have made development of high technology an important part of their political strategy.

China's national strength is currently limited, so it cannot compete all-out with the developed countries in the high technology field, but it also cannot remain unconcerned. We must adopt a direction of limited goals and breakthroughs in key areas, formulate solid policies and measures, follow world levels in certain important areas and strive for breakthroughs in areas where we are strong to serve existing traditional industries and build new industries, gradually shifting our entire economy to a new technological foundation.

In the past few years China has made advances in such areas as information technology (large-scale integrated circuits, computers, software, and communications), biotechnology, new materials, space technology, remote sensing technology, laser technology, isotope and radiation technology, and superconducting technology. We will now summarize the overall situation.

Section 1. Large-Scale Integrated Circuits

The information industry is a new industry which shapes modernized productive forces and occupies a very important place in the national economy. Integrated circuits are the foundation of the electronics and information industries.

1. Internationally, since the appearance of the integrated circuit in the fifties, we have gone through three stages: in the sixties medium and small-scale integrated circuits (integration below 1,000 components/chip) were developed, in the early seventies large-scale integrated circuits (1,000-10,000 components/chip) were born and in the early eighties, super-large integrated circuits (100,000-1,000,000 components/chip) were developed and now we have megabit MOS dynamic memory (integration of 2.25 million components/chip). It is predicted that by the end of the eighties 4 megabit dynamic memory and 64-bit micro-processors will appear.

During the seventies, the degree of integration of integrated circuits increased on an average of four-fold per year but the average cost dropped

27.5 percent per year. The diameter of silicon chips used in production increased every 4 years by 1 inch, and now gradually are making the transition from 4 inches to 5 inches and even to 6 inches. Correspondingly, industrial equipment is replaced by a new generation every 3-5 years.

In terms of the smallest photoetching line-width, the processing precision level of eighties production technology has reached 1-2 microns, and research is now exploring the realm of sub-microns (see Table 1). The primary raw material of integrated circuits is still primarily silicon, but the typical speed of gallium-arsenide digital circuits is several magnitudes faster than silicon ECL4 circuits and such countries as the United States have made development of gallium-arsenide ultra-fast logic circuits a national-level research project. In the realm of memory and microprocessors, MOS technology dominates but due to the low power density demands of very large-scale integrated circuits, unquestionably CMOS technology will eventually occupy an important position. The proportion of custom and semi-custom circuits will increase rapidly in the market.

Table 1. Development and Projection of Semiconductor Dynamic Memory

Year	Number of MOS memory bytes	Photoetching dimensions
1970-1971	1Kb	10 microns
1973	4Kb	6 microns
1976	16Kb	4-6 microns
1979	64Kb	2-3 microns
1981	256Kb	1.5 microns
1984-1985	1Mb	1 micron
1990	4Mb	0.5 microns
Nineties	16-64Mb	<0.5 microns

In 1984 sales on the world integrated circuit market reached $21 billion, a 55 percent increase over the previous year (see Table 2). The growth rate in the last 5 years of the eighties is estimated to average 12.5-18 percent per year, and the volume of sales in the 1990 market is projected at $47-63 billion. According to 1982 statistics, the U.S. share of the international market was 58 percent, Japan's 23 percent, West Europe's 15 percent, and other countries' 4 percent.

Table 2. Sales of Semiconductors on the World Market (Unit: $1 billion)

Type	1983	1984	1985	1986	1990
Total of semiconductor components	18.153	26.935	28.799	31.855	55.0-75.0
Integrated circuits	13.535	20.979	22.867	22.867	47.0-63.0
Component circuits	4.618	5.956	5.932	6.324	8.0-11.0

ELECTRONICS WEEK, 1985, 1.1

In 1982 the United States and Japan together produced over 13 billion integrated circuits, including over 5.6 billion large-scale integrated circuits, in other words, large-scale integrated circuits made up over 40 percent of the total output of integrated circuits. In terms of product mix, digital circuits accounted for 70-80 percent, and linear circuits, 20-30 percent.

The reliability of foreign integrated circuits is 10^{-7}-10^{-8}. The finished product rate of medium- and small-scale integrated circuits is about 90 percent but that of low-end large-scale integrated circuits can be about 80 percent.

2. China's research and development of integrated circuits began in 1964, they went into production in the late sixties, and in 1975 large-scale integrated circuits were developed. Nationally, there are 10 mainstay integrated circuit plants and 7 primary research agencies. In the entire industry there are about 40,000 persons, of which approximately 5,000 are technicians. From 1976 to 1981 the output of integrated circuits hovered around 10-30 million pieces, and in 1981 it began to increase at an annual rate of 38.4 percent. In 1984, 39.28 million pieces were completed, and in 1985 output reached approximately 54 million pieces of which 21 million were large-scale integrated circuits, or about 4 percent. In 1985 China's integrated circuit output was equal only to the output of the United States in 1967 and Japan in 1969 (see Table 3).

Table 3. Output and Growth Rate of Semiconductors in the United States and Japan During the Early Years

Japan			United States		
Year	Output (10,000)	Annual rate of increase	Year	Output (10,000)	Annual rate of increase
1966	29.2		1963	50	
1967	334	10-fold	1964	220	3.4-fold
1968	1988	5-fold	1965	950	3.3-fold
1969	5023	1.5-fold	1966	2945	2.1-fold
1970	11994	1.4-fold	1967	6900	1.4-fold

Note: Japan's average annual rate of increase from 1968 to 1981 was 41.9 percent.
Data from Japan's 1975 electronics industry yearbook.

Industrial production has already mastered the technology of line widths of 5 microns and there are over 890 integrated circuits which meet international standards. Product reliability generally reaches 10^{-6}, but some may reach 10^{-7}. The primary integrated circuit enterprises are equipped with 3-inch-diameter production lines, and individual enterprises have achieved industrialized production levels, with the performance/price ratio of some medium- and small-scale integrated circuits approaching current international levels.

Since 1979 many achievements have been made in key areas of large-scale integrated circuits. In terms of microprocessors, we have already developed the 6800 and 8085 8-bit series and a 4-bit series. In terms of memory, we have developed 3 power source 16K dynamic, 4K static RAM and 8K EPROM. Typical products which meet the standards for the single power source 16K dynamic, 16K static RAM and 16K EPROM have already been made. Scientific research has mastered the 3-micron industrial technology and is now carrying out development work on a 64K dynamic RAM and a 16-bit microprocessor. In terms of basic materials, the quality of monocrystal silicon has clearly improved; over 40 key materials such as an ultra-micronized ganban [1626 3652] and photoetching jiao [5231] have been developed; 12 hyperpure chemical reagents have reached Japan's zero-level standard. In terms of specialized equipment we have begun to form a 3-inch production line system capability.

3. Several problems which must be resolved in China's scientific research and production of integrated circuits.

1) In the Sixth Five-Year Plan period, in the product mix of China's integrated circuits the increase in consumer type products was very rapid. But investment type products, such as microprocessors and memory circuits, made up less than 5 percent of total output. Computer-type and communications-type integrated circuits have not yet become a product sets. This means that the proportion in the product mix is still not rational. In the future, in addition to continuing to develop consumer products to satisfy the needs of people's lives, we should accelerate the development of investment-type products.

2) Stress product quality, improving reliability, lowering costs, striving to develop new types of products, and adopting international standards, are current urgent tasks in integrated circuit production.

3) Large-scale integrated circuit scientific research techniques are backward, the difference between basic research and product development and design capability are basically at copying stage.

4) Special purpose equipment and basic raw materials cannot catch up with the needs of development, the self-equipping ability of the integrated circuit industry is very weak. Chinese-produced special purpose equipment still cannot satisfy the demands of stable 3-inch silicon chip 5 micron technology stability.

5) The integration of scientific research and production lines already imported should be strengthened and the appropriate economic benefits developed as rapidly as possible.

4. Seventh Five-Year Plan Targets

1) Develop 750 new products for a cumulative total of more than 1,600 by 1990.

2) An average annual growth rate of 50 percent.

3) Put VLSI 3 micron technology represented by the 16-bit microcomputer into mass production.

4) As early as possible make a breakthrough in 1-2 micron VLSI technology and follow world levels and develop sub-micron technology research.

5. To realize the strategic goals of the Seventh Five-Year Plan period, integrating the existing situation in China's integrated circuit industry requires the adoption of the following policy measures.

1) Further implement the policy of an open door toward the outside and invigorating the economy inside China, fully utilize the favorable conditions internationally, mobilize the initiative of both central authorities and local areas, and comprehensively implement the guideline of "import, digest, develop, and create."

2) Train personnel, strengthen developmental research on integrated circuit design technology, and as quickly as possible cast off the current situation of purely copying.

3) Implement the policies of limited protection and support to promote the development of China's integrated circuit industry.

4) Vigorously accelerate the development of basic materials and special purpose equipment.

Section 2. Computers

Computers are a powerful technique for developing information resources and a new productive force which can produce enormous socioeconomic benefits. The rapid development of computer technology is causing profound changes in science and technology, the economy, military affairs, and even in domestic life. For this reason, the level of scientific development, scale of production, and range of application of computers has been regarded as an important indicator of national economy and military strength. All countries take the development of computers very seriously.

Computers are generally divided into: supercomputers, large-scale computers, minicomputers, microcomputers, pocket calculators, Chinese character information processing systems, analog and hybrid computers and their major components such as peripherals, software, and network communications.

1. Development Overview

Since the first computer appeared in the forties, product technology has evolved through four generations. The primary component of the first generation computer was the vacuum tube, for the second generation it was the transistor, the third generation used the medium- and small-scale integrated circuit, and the primary component of the fourth generation made the

transition to the large-scale and very large-scale integrated circuit. Currently, the development of the fifth generation computer has caught the attention of the world and has made substantial progress. Significant advances have been made in industrial composition and production technology and the changes in varieties is also great. When IBM of the United States put out the 360 medium- and large-scale computer in 1964, it indicated that computer technology had matured. Then, the U.S. Digital Equipment Corporation developed a fully compatible minicomputer with a better price/performance ratio greatly expanding the computer's range of application and expanding from digital calculations to real-time control. In 1972 the United States produced the microcomputer, which by 1983 numbered 5 million. The development of supercomputers is progressing very rapidly and recently the Japanese announced the development of a supercomputer which could carry out 10 billion instructions per second.

At present, technologically we are breaking through the traditional vonNeumann computer system structure and developing in the direction of a fifth generation computer which can process in parallel, can accept natural language, has intelligent processing capability, and can carry out high speed operations. The development of the integrated circuit which is the important basis for computer technology every 10 years makes computer costs lower by one magnitude and increases performance by one magnitude. In the past 40 years, computer performance has increased by 6 magnitudes, and costs have dropped by 4 magnitudes, a phenomenon rarely seen in other industries. As the computer cost/performance ratio improves, there should be increasing expansion in the range of applications.

2. Research, Development, Production, and Application of China's Computers

In 1956 the "Twelve-Year Science and Technology Development Plan" formulated by the state made computers one of the important development projects and adopted urgent measures to establish China's first computer science and technology research agency--the Institute of Computer Technology of the Chinese Academy of Sciences. With the full cooperation of research, development, production and applications departments, China's first minicomputer, the "103," and large-scale computer, the "104," were developed in 1958 and 1959, respectively. In 1965 a second generation transistorized computer was designed and went into production. In 1970 a third generation medium and small-scale integrated circuit computer was developed. In this period, many departments and regions of China established computer research institutes, plants and computer centers (stations), and many institutions of higher learning established computer departments or specializations.

In 1973 China began to develop serialized, general purpose, standardized computers. In August 1974, the 1130 (formerly the DJS130) multifunction mini general-purpose digital computer first passed appraisal, and then the 1000 and 2000 series minicomputer series, the DJS200 large and medium computer series, the 0500 and 0600 microcomputer series and the DJM300 analog computer series were developed and put into small batch production and use. The development of computer series played a very stimulating role in the development, production and application of China's computers.

Since 1979, the computer industry has clearly proposed a development direction which places "emphasis on applications" and is "directed toward applications." In product development, we have formulated a direction of emphasizing minicomputers and developing large, medium and mini computers in concert and advocating comprehensive adoption of international standards, fully utilizing more liberal conditions, and taking the technological development road of "importing, digesting, developing, and creating."

China's computers were begun with scientific research and now we are gradually developing a new industrial sector which includes scientific research, product development, production manufacturing, and application service. The basic situation is as follows:

Primary industrial production capability is in the Ministry of Electronics Industry system. According to 1984 statistics, there were 130 computer enterprises nationwide including: 83 computer and accessory plants, and 47 peripherals plants. The total number of employees was 89,816, including 15,275 technicians. During the year 294 large, medium, and mini digital computers were produced, double the figure for 1983; 87 analog computers were produced, a decline of 26.9 percent over 1983; 27,089 microcomputers were produced which is a six-fold increase over 1983; 71,657 pieces of peripheral equipment were produced, a four-fold increase; and 50 industrial robots were produced.

Research development. China's computer research strength is primarily distributed in the Chinese Academy of Sciences, institutions of higher education, and industrial departments. Among them are five institutes directly subordinate to the Ministry of Electronics, five institutes under the Academy of Sciences, and 14 institutes under the provinces and municipalities. Several tens of schools and colleges of higher learning such as Qinghua University, Beijing University, Nanjing University, and the National Defense Science and Technology University also have strong computer science development capabilities.

At the end of 1983, China developed a 10 million instructions per second vector computer and a 100 million instructions per second super computer, indicating that China's computer technology had reached a new level. Soon after, we developed the YH-XI, KSJ2730, NC12780 super-minicomputer and the YH-FI fully digital computer for simulation, the Changcheng 0520 microcomputer series, the Cijin microcomputer series and the computer-laser Chinese character editing-typesetting system. But in comparing the levels of science and technology and production with advanced world levels, a big gap remains.

Computer applications. Before the seventies, China's computers were used basically for numerical calculations, but in the late seventies this was expanded to such areas as process control, data processing, economic management, information searches, and artificial intelligence. After entering the eighties, there was a big development in China's use of microcomputers, but the applications rate still must be improved.

3. Problems Which Must Be Further Resolved

Computer technology is a new enterprise which China is currently developing and two important problems which must be studied and resolved are:

1) We have not yet been able to establish competitive modernized computer manufacturing and it is not suited to the demands of the four modernizations. We import too many computers and the cost is too high. They exceed sales of domestically manufactured computers. In terms of China's actual circumstances, we must rapidly improve our high technology development ability, improve the management system, and work hard to improve the performance/cost ratio of our products, and we must adjust the investment ratio between the computer industry and traditional industries so that this new industry of computers can develop even faster and reduce the big gap which has grown with advanced world levels.

2) Further improve overall planning, strengthen scientific research, and clarify the tasks of each scientific research unit to achieve a rational division of labor. At the same time, formulate laws and regulations beneficial to the development of computers, protect and support national industry, establish computer science research and the industrial production system and training system.

Section 3. Computer Software

Software is the programming and documentation in a computer system, the interface between the user and the hardware, the command center of a computer system. The development of software should be based on hardware, and at the same time should also promote the development of hardware and the development of computer science and engineering technology and other related departments.

The software industry is characterized by a concentration of knowledge, technology and labor and very high economic benefits. With the development of computer science and engineering, software also developed into an important industry. Implementation of the policy of parallel development of components, hardware, and software liberating software from a position purely subordinate to hardware service and transforming it into an independent industry has become a trend.

The development of computer software in the world has gone through four stages in the last 30 years. The fifties was the first stage, the initial stage of programming design, i.e., "the embryonic stage." In the late fifties we entered the second stage, i.e., "the formative stage": high level programming languages and their compiler systems appeared, some full-function operating systems, network software and database techniques were researched and designed, and software products began to enter the market. In the late sixties we entered the third stage, i.e., the stage of program design method theory: at this time since the software that remained to be developed was large in scale and of a high degree of complexity, it was difficult to ensure product quality, and at the same time there was a shortage of software personnel, productivity was low, developmental expenses rose daily, so that

there was a serious dislocation in the supply and demand relationship in software products and a "software crisis" appeared. After the International Software Engineering Conference in 1975, software techniques entered the fourth stage, i.e., the initial stage of software engineering.

With the rapid development of such areas as information processing and real-time control which are applications based primarily in scientific calculations, many new applications areas were established, such as computer networking, robots, artificial intelligence, computer-aided design, computer-aided manufacturing, and computer-aided instruction. In the developed countries they are not limited only to such applications as factory and office automation, but are also moving toward domestic automation. The volume of demand for software has increased suddenly, the software market is expanding and the value of production is increasing.

Some developed countries have adopted major measures for the development and protection of computer software. The United States vigorously supports and encourages companies to expand software work comprehensively and has become the most advanced software producing country in the world; the value of production of U.S. software products reached $2.6 billion in 1980, $3.5 billion in 1981, $4.7 billion in 1982, $6.2 billion in 1983, and $8.3 billion in 1984. The Japanese Government has formulated an industry encouragement law, announced a software development plan, and established a subsidy system to support software. In 1980 the volume of software business was $638 million.

The developing countries are also vigorously developing software industries. For example, Brazil is utilizing its own dominant position and plans to establish a modernized software plant to employ 600 persons within 5 years. India has made computer software a priority development area, and is trying to become a major software exporting country. Beginning in 1974, the volume of software trade increased at an annual average growth rate of 80 percent, in 1979 it was $4.4 million and in 1981 it was $14.4 million.

China's computer software development began in the late fifties and there was major development in the early seventies. The Chinese Academy of Sciences, some institutions of higher learning and industrial departments have begun research and development work in such areas as operating systems, real-time control systems, database and computer networking, have developed some general purpose and dedicated applications software, and compiler implementation techniques have developed to a rather mature stage. Important institutions of higher learning have established departments of computer science and engineering and have trained a group of software talent. In this period, computer applications have also begun to expand from computers for science and engineering to the realm of real-time control and data processing, so that there have been substantial developments in applications software. The benefits particularly in national defense, machine-building, hydroelectricity, meteorology, petroleum, construction, communications and transportation, and medicine have been especially clear. Research on Chinese character processing techniques and Chinese character processing systems have developed to the point of widespread attention and some projects have achieved high levels. In the early eighties, China's software workers

devoted attention to the importance of software engineering in improving software productivity and software quality, shortening development periods, and lowering costs, and have formulated some corresponding measures, carried out development of a software engineering environment foundation, begun to formulate engineering range and standards, discussed creating software factories in order to try to get China's software to enter the stage of industrial-type production as soon as possible.

In the Sixth Five-Year Plan, the state has invested 25 million yuan in 50 key projects related to computer applications software development and obtained clear benefits. In the Seventh Five-Year Plan, the state investment in computer software will grow substantially. In addition, production departments and local areas will also make corresponding investments. During the Seventh Five-Year Plan we should concentrate our efforts on establishing a group of mainstay units of a software industry. Key state projects are development of industrialized software production and techniques for managing it; development of system software and support software; Chinese character information processing techniques and their application; general purpose software and software packages as a developmental foundation for various types of applications software; applications systems for important sectors of the national economy; artificial intelligence and intelligent software systems; and software theory. After the completion of the Seventh Five-Year Plan, China's software technicians may number over 100,000 persons (an annual average growth rate of 30 percent), China's level of software technology may be able to reach the levels of international technology in the early eighties. The value of software production will make up one-fourth to one-third of the total value of all computer manufacturing production.

China's software technology development did not start too late, but due to the lack of a development direction clearly oriented toward applications in the past, it was not able to form an industrial-level software development capability; software technicians were in short supply, they were scattered, and the internal structure and levels were irrational, there was a particular shortage of high level software engineers, high level software managers, systems analysts and software personnel with specialized knowledge of applications areas. The ratio of software and hardware personnel is out of balance (U.S., 7:1; Japan, 4.3:1; China, 1:3). We lack equipment which consists of complete systems, has stable reliability, and is for advanced uses so that in comparing China and the developed countries there is a very large gap between levels and output. This situation has become a serious obstacle to China's promotion and application of computers, and must cause a high level of concern. It should be recognized that China has such favorable conditions as abundant resources of intelligence, a certain competitive ability in the international software market, and a certain technological foundation, and if only we have a clear development direction and policies, adopt resolute and forceful measures, stress training, organization, and deployment of personnel, we can establish China's software industry faster and turn around a passive situation.

Thus, in the years ahead we should do the following:

1) Strengthen macro-management, formulate effective management regulations and laws focused on the special features of the software industry, avoid low quality duplicate development of large amounts of software between units, improve the decentralized situation in establishment of a software corps and software production.

2) We should vigorously support the development of system software which has broad impact and a powerful foundation. Give serious consideration to developing applications software and software engineering technology, and promote the industrialization of software.

3) Conscientiously organize the importation, digestion, and promotion of application of advanced software from abroad, and strive to avoid duplication in importing.

4) Actively support software circulation, formulate software product pricing policies and software protection laws, ensure the legal rights and interests of owners of technology.

5) To accelerate the training of personnel we should adopt methods from middle school to university and from formal schooling to after-hours education and carry out multileveled and multipath education and training of personnel.

Section 4. Communications

Communications is the transmission and exchange of information. In modern society communications is the nerve system of the national economy and modern national defense; it accelerates the circulation of information, circulation of funds and circulation of goods, and creates a great deal of wealth for society. According to estimates, 10 percent of the national income of the developed countries is derived from communications.

The characteristic of modern communications technology is that it combines computers and communications, bringing about sweeping changes in the realm of communications. Traditional analog communications will develop in the direction of digitalization: speech, images, sounds, writing, and data information will be transmitted, exchanged, and processed in digital form in an integrated operation digital network. Fiber optics communications, satellite communications, digital microwave communication, programmed controlled switchboards and integrated operation digital network technology will satisfy these needs.

1. Optical Fiber Communications

Fiber optics communications is a new application science technology which developed rapidly in the early seventies. It is a brand-new line communications method which uses optical frequencies as the carried wave and light conducting fibers as the transmission lines. This type of communication has

the advantages of low loss, wide frequency band, resistance to electromagnetic interference, low cost, excellent adaptability and abundant resources, and is an important mainstay of future communications society's comprehensive service digital communications networks. Since fiber optics communications has clear technological and economic benefits, various countries regard it very highly. The United States, Japan, England, France, and the Federal Republic of Germany have all indicated that in the future, they will no longer build coaxial cable systems for trunk line communications but will replace them with optical cable systems.

Beginning in 1979, China established pilot and test circuits in Beijing, Shanghai, Wuhan, Guilin, Nanjing, and Tianjin. In 1983 a 13 km quadratic group (120 voice circuit) system was completed in Wuhan, in 1985 a tertiary group (480 voice circuit) system was approved. In 1984 a 7 km tertiary group system was approved in Tianjin. In 1985 a 27 km dedicated system which basically achieved a useful level was set up in Beijing. And it was further expanded to Beijing, Harbin, Shijiazhuang, Chengdu, and Guangzhou.

However, we are still at the stage of medium and small capacity, medium and short distance multimode communications system technology, we have not yet made the breakthrough to high capacity quartic group (1,920 voice circuit) systems and are only beginning research on single-mode optical fibers.

During the Seventh Five-Year Plan, on the foundation of consolidating and extending the multimode system applications technology, China's emphasis will shift to developing longwave long single-mode long distance communications applications technology and systems and will lose no time in developing experimental undersea optical cable systems, establish some demonstration projects and form a partial network. At the same time, we will further develop such technologies as optical wave technology, coherent optical communications, integrated optics, and special optical fibers. Under unified planning we will gradually form a coordinated, uniform optical fiber communications industry.

2. Microwave Communications

Microwave communications is communications in which a certain number of interrupt stations are established at both ends of a circuit along the earth's surface and the signal is transmitted in relay fashion, therefore it is called microwave relay communications. The interrupt distance is generally 50 km. The microwave frequency band is between 300MC and 30,000MC.

Microwave communications has the advantages of broad frequency band, large capacity, ease of establishing stations, powerful resistance to disasters, and economical investment, therefore it is widely used in the world. For example, microwave circuits account for 72 percent of the long distance communications in the United States (of which 65 percent is microwave interrupt communications and 7 percent is satellite communications); and in the other developed countries it generally accounts for 50-70 percent.

China currently has 14,000 km of analog microwave communications circuits connecting 25 provinces and municipalities, and assumes the responsibility for long-distance high transmission broadcast television, television instruction, telephone, newspaper facsimile, and digital operations; there is also a dedicated microwave communications system of nearly 10,000 km. We are in the process of building a secondary group digital microwave dedicated communications system. A tertiary group design was settled in November 1984 and may provide separate technical equipment. A larger capacity quartic system is now in research and development.

Compared to the developed countries, the proportion of microwave communications in China's communications is much too small (only 6.5 percent) and the technical equipment is rather outdated. The advanced technology which has been developed still must be put to use. In the new 5-year plan we are arranging for new development and reformed projects and will also open some new microwave communications circuits. At the same time, we will stress security technology of microwave broadcasts and research and development of equipment.

3. Satellite Communications

Satellite communications systems are made up of satellites, ground stations, and transmission systems. The function of the transmission system is to link the satellite and the ground station, carry out signal processing, modulation and multiple address linking.

Since the United States launched the first experimental communications satellite in 1958 and a stationary communications satellite in 1963, satellite communications has developed more rapidly into an important part of modern communications. Currently 70 percent of international communications are borne by satellite communications systems. Internationally, satellite communications has gone through five generations and the sixth generation is currently being developed. It is estimated that in 1986 the No V satellite will reach saturation and that the No VI satellite will be launched by the space shuttle for the first time.

In the future, satellites will have computing and memory function components to facilitate carrying out some complex function processing which is currently done on the ground, which will greatly lower information processing by ground stations.

China began to explore satellite communications technology in the mid-sixties, in the seventies first formulated satellite communications development plans, in April 1984 launched an experimental communications satellite, in September 1985 several satellite ground stations were established in remote regions within China, and in February 1986 a communications broadcast satellite was successfully launched.

4. Program Controlled Digital Switchboards

The program controlled digital switchboard is the central equipment of a digital communications network. Because it has the advantages of small mass, economical power consumption, high reliability, and ease of maintenance, it can provide the user with many new operational functions and thus it is developing very rapidly.

Currently third generation program controlled digital switchboards (i.e., modularized structure, distributional processing) are already going into use widely internationally; fourth generation digital switchboards (which can switch voice and data simultaneously) will soon go on the market; fifth generation (broad-band operational) are now under development.

In the early eighties China began research and development in this area of technology, during the Sixth Five-Year Plan we made some advances, and developed some small capacity program controllers. During the Seventh Five-Year Plan we are arranging for new development tasks so that China will master this advanced technology as rapidly as possible.

5. Communications Networks

The transmission and exchange of information in modern society is primarily realized through communications networks. A perfect communications network not only makes people's lives easier, but also can greatly improve social production's efficiency and economic benefits and promote the progress and development of society. Thus, the world's countries have made enormous investments to build modernized communications networks.

The developed countries have constructed automated analog networks which are gigantic, have microwave and coaxial cable as their primary method, and in which electro-mechanical system is the primary method of switching, and they are making the transition to digitalization. China's public network construction primarily of overhead lines is small in scale and technologically backward. To change this backward situation, during the Seventh Five-Year Plan we will research and develop an integrated operations digital network and will develop a national public communications network system for use by banks, aviation, railways, hydroelectricity, and national information centers.

Section 5. Biotechnology

Biotechnology is based in the biological sciences. It uses biological systems (tissues, cells and their constituents) and engineering principles to provide commodities and comprehensive science and technology for society, and primarily includes the four areas of genetic engineering, cell engineering, enzyme engineering, and fermentation engineering.

1. The Development of World Biotechnology

The governments of the world's countries are all actively investing in biotechnology (see attached table). The countries that are developing the fastest are the United States, Japan, England, the Federal Republic of Germany, France, and Switzerland.

Countries' Investment in Biotechnology

Country	Investing department	Year	Total government investment	Equivalent annual investment in $US
U.S.	Government	1983	$511 million	$511 million
	Private enterprise	1983	$1.1 billion	$1,100 million
Japan	Government	1980-81	Y120.7 billion	ca. $240 million
	Private enterprise	1982	$217 million	$217 million
France	Government	1982-85	$880 million	$880 million
	Private enterprise	1982	$115 million	$115 million
Fed. Rep. Germany	Government	1983	DM63 million	ca. $20 million
	Government	1985-89	DM1 billion	ca. $70 million
	Private enterprise	1982	DM90 million	$30 million
England	Government	1983	Ł35 million	ca. $40 million
Canada	Government	1981-91	$483 million	ca. $40 million
India	Government	1982-84	Ł15 million	ca. $6 million
Holland	Government	1982-88	$29.4 million	ca. $4.2 million
Sweden	Government	1981-82	$1.9 million	$.95 million
	Government	1983-84	$6.1 million	$3.05 million
European Community	Government	1982-86	$8 million	$1.6 million

Beginning in the late seventies, biotechnology in the advanced countries entered the practical stage. In medicine and public health, genetic engineering methods were used to produce insulin and human growth hormones; the monoclone antibodies produced using cell engineering were released to the market in the early eighties, and it is estimated that by 1990 the sales of these three medicine products may reach $1.8-$1.9 billion. Foot-and-mouth disease vaccine, B-type hepatitis surface antigen, and rabies vaccine manufactured through the use of genetic engineering methods have already or are about to come on the market. Using biotechnology for antibiotic bacteria improvement and production has had evident economic benefits, and the development of gene treatment is also very rapid.

In light industry and foods, microorganism fermentation is used to produce single cell protein whose efficacy is many times higher than the albumen produced by domestic animals and fowl, and many countries have gone into large-scale industrialized production. An industry in high fructose syrups obtained from starch by fermentation has already arisen, and currently one-third of the industrially used sugar in the United States is obtained this way. Such fixed huamei [0553 5326] as amino acid xianhuamei [7913 0553 5326],

glucose isometric enzymes, and lactase are already used in food production.

In agriculture, forestry, animal husbandry and fish culture, China and other countries are using haploid breeding techniques to breed high-yield paddy rice and wheat varieties. Tissue cultivation techniques have been used for rapid propagation and production of over 10 economically valuable crops. In the United States, England, and France, bovine embryology transplants have reached the stage of commoditization and an international embryo export business has developed.

In other areas, some microbial pesticides which can reduce environmental pollution have been put into commercial production. The bacterial ore-extraction method has been used in production of copper and uranium production. Microbial polysaccarides with broad applications have entered industrialized production. The use of biomass energy to produce methane has been widely used and the use of biomass energy to produce alcohol as an energy source is already in operation in some countries. For example, in 1984, in Brazil, alcohol produced using sugarcane and cassava accounted for 43 percent of the fuel required by automobiles.

2. China's Biotechnology Development

China has a long history of using traditional biotechnology to produce liquor, soy sauce, vinegar and other fermented food products. In the late fifties, China established an antibiotic industry. Following that, such fermentation products as amino acids, zymins, citric acid, vitamins, steroids, and nucleic acid medicines have been in production and a modern biotechnology production system has gradually taken shape. China's annual antibiotic production is now in first place in the world, exceeding 10,000 tons; glutamic acid production is 75,000 tons; production of primary zymins widely used in textiles, sugar-making, detergents, tanning, and pharmaceuticals production is over 20,000 tons. China currently has over 100 types of biotechnology products whose value of production accounts for about 1 percent of the gross value of production of the national economy.

Since the seventies, China has engaged in basic applications research on such modern biotechnologies as genetic engineering. Some important research results have been obtained in such areas as medicine and public health, agriculture, forestry, animal husbandry, fisheries, light industry and foods, and the chemical industry. Some genetic material from foreign sources, such as the B-type hepatitis virus surface antigen gene, and interferon have been cloned and expressed in procaryotic and eucaryotic cells and have established a foundation for producing genetically engineered vaccines and activated peptides. Seventy-four types of monoclone antibodies have been developed using lymphocyte hybrid tumor technique and diagnostic kits have been marketed on a trial basis with the output value of B-type hepatitis virus surface antigen monoclone antibody diagnostic kits in 1984 at 630,000 yuan which increased in 1985 to over 2,000,000 yuan. China's anther culture and haploid breeding techniques are in the leading place in the world, and 19 varieties of such haploid plants as wheat, corn, rubber, poplar, and

citrus were developed in China and some new varieties have been obtained. The planting area of haploid paddy rice, wheat and tobacco have increased to 400,000 mu, 2,000,000 mu, and 150,000 mu, respectively, and obvious economic benefits have been received. Some achievements have also been made using tissue culture methods to rapidly reproduce flowers and plants, forest trees, and sweet potatoes. For example, Guangxi has established a rapid reproduction shop for sweet potato plants which produced in an annual test 3 million plants. Efficiency is 1,000 times higher than conventional seedling raising methods, and the planted area has reached 50,000 mu. Using bioplast cultivation and fusion technology the bioplast reproduction plants of 21 types of plants in 10 families have been obtained and tobacco shi ai qian niu [0577 4253 3677 3662] isosomatic hybrid plant has been obtained. Using biological, physical, and chemical factors to induce mutation of microorganisms we have cultivated a group of highly productive fungi which produce antibiotics, amino acids, organic acids, and zymin preparations. For example, the penicillin-producing capability of a newly cultivated fungus that produced penicillin was increased by 60 percent, and between 1980 and 1981 alone the additional profit beyond the quota was 44 million yuan. The activity of the new saccharogenic enzyme fungus was improved 16-fold over the original fungus and it has been extended to the entire country and can save more than 200,000 tons of edible sugar annually at a saving of 80 million yuan.

In addition, in applying animal and plant cell cultivation techniques on a large scale to produce valuable medicines deng [4853] secondary metabolic end products, domestic animal embryo transplanting, control of fish sex, fixed huamei, single cell protein, microorganic pesticides, bioenergy sources, bacterial metallurgy and microorganic processing of industrial waste water have all made advances to varying degrees.

3. The Goals and Policies of China's Biotechnology Development

In general, there is still a large gap between the level of China's biotechnology research and development and that of the developed countries, and within the country it is not adapted to the demands of economic development. The main manifestation is in the insufficiency of researchers, the decentralization of strength, and the mismatch of specializations; basic research is weak, and research and development are seriously out of line; technology is mismatched, it is very difficult to transform research results into productive ability; the level of traditional biological industrial technology is low and equipment is outdated.

To rapidly change this situation, our developmental goals for the next 15 years are:

1) Concentrate our forces, make breakthroughs in key areas, develop in a prioritized way some new biotechnology products for which there is an urgent need domestically, which are technologically mature, whose economic or social benefits are evident and for which we have a foundation or the conditions domestically, such as monoclone antibodies, genetically engineered vaccines, amino acid series products, new food zymins, single cell protein, fine animal

and plant varieties which are high grade, resistant, and highly productive and which were cultivated using a combination of biotechnology and conventional breeding, and applying tissue culture and embryo transplant technology to carry out improvement and rapid reproduction of animal and plant varieties.

2) Actively adopt modern biotechnology to accelerate improvement of traditional production in order to raise the level of technology and equipment, increase varieties, improve output, save on energy and raw materials, and reduce pollution. Major improvements can be made in key areas through selective breeding of fine fungi, development of fermentation and refining equipment and monitoring and analytical instruments, adoption of enzyme engineering and development of new engineering technology in the antibiotics, zymin, and starch industries as well as the alcohol and seasoning industries.

3) Closely associated with the establishment of new industries and the improvement of traditional industries, organize and arrange basic research, applied research and developmental research, establish and improve technological systems which play a key role in biotechnology development, such as biological reactor technology, refining technology of biotechnology products, cell fusion, protoplast and cell regeneration technologies, and genetic engineering technology.

To realize the above goals, we will adopt the following policies:

1) Improve leadership and coordination of biotechnology research and development, plan the arrangement and coordination of basic research, applied research, intermediate testing, promoting applications and training of personnel, concentrate our forces and organize attacks on key problems, and advance the conversion of the results of scientific research into productive forces.

2) Accelerate training and gradually develop a comprehensively specialized and rationally administered biotechnology corps.

3) Actively develop international cooperation, establish and open laboratories, import needed technology and organize its digestion and absorption.

4) Establish and consolidate the necessary sets of basic facilities, such as the production and supply of such things as experimental organisms, tool enzymes, and dedicated instruments and materials, and the establishment of such basic facilities and cell, fungus, and data banks.

5) Develop legislative work on biotechnology, such as the formulation of safety laws, new product quality standards and appraisal, registration conditions, and laws protecting biological resources.

6) Develop soft science research of biotechnology to provide a scientific basis for national macropolicy formulation.

Section 6. New Materials

New materials refers to materials which have been newly developed or are currently being developed and which have outstanding characteristics or special functions, and refers to an important part of information technology, biotechnology, new energy sources technology and other new technologies. Its development is generally taken very seriously by the countries of the world. The industrially developed countries in particular have made new materials an important area for priority development.

The development of new materials in China began in the late fifties. Over the past 20-odd years, we have developed more than 10,000 types of new materials, established a research, testing and production base and created a science and technology corps. According to statistics, China currently has 150 research academies and institutes, over 30 institutions of higher learning, over 430 factory enterprises, and approximately 80,000 engineers and technicians working on research and development of new materials. The main research and development is on new materials in such areas as metals, organic high molecules, and inorganic nonmetals. We have formed new materials industries in such areas as semiconductors, special metals and alloys, new chemical industry materials, new inorganic nonmetals, new fuels and synthetic lubricating oils. Development of new materials has forcefully advanced the establishment and development of such new technologies as the electronics industry, integrated circuits, computers, and new energy sources, and basically can adapt to the needs of national economic construction and national defense key area construction.

To accelerate the development of new materials, in 1982 the state made development of new materials a key project including four areas: 1) new materials for key national defense projects; 2) organic silicon, organic fluorine, organic glass and other new high molecular materials; 3) new materials for electronic information; 4) energy source and energy saving materials such as steel for use in atomic energy. After several years of effort, we have made some encouraging results. Some of these scientific results have already been converted into productive forces and have brought great economic and social benefits in economic construction, national defense construction and everyday lives.

Although China has made great achievements in new materials, compared to the developed countries, whether in varieties, quality or costs, there is still a sizeable gap in the research and development technological level, research test conditions, and analytical and measurement techniques, and in the face of the challenge of the world revolution in new technology China's mission for the time being is fairly formidable. For just this reason, development of new materials has been made a national key projects area of the Seventh Five-Year Plan period. These key projects include both topics promoting the reform of traditional industrial technology as well as topics on providing the necessary material foundation for developing high technology and creating new industries, and also includes some topics for catching up with and overtaking advanced levels and for research in advance for laying a foundation for future development.

Section 7. Aerospace Technology

Aerospace technology is a comprehensive high technology which came into being in the fifties. It is a high technology for exploring and developing outer space, developing aerospace industry, promoting the advance of military affairs, the economy, science and culture. As aerospace technology continues to develop, aerospace industries will produce an ever greater influence on human society.

1. The Development of the Aerospace Industry

Since the Soviet Union first launched an artificial satellite on 4 October 1957, aerospace technology has progressively entered the stage of practical application and high commoditization, and formed an important new industry. By the end of 1984 the countries of the world had launched a total of 3,239 satellites and spacecraft (see Table 1) at a cost of over $400 billion (see Table 2). The annual investment in the U.S. aerospace industry in recent years has been $10-20 billion, which accounts for 0.5 percent of the GNP, and over 100,000 persons are directly involved in aerospace activity. In 1984 the Soviet Union's outlays on space activity was $35 billion, accounting for 1-2 percent of the GNP, and several hundred thousand persons were directly involved in aerospace activity. Europe and Japan intensified the development of aerospace technology. Such developing countries as India and Indonesia also got actively involved in space activity.

Table 1. Statistics on Successful World Space Launches (1957-1984)

Country	Number of launches
Soviet Union	2,011
United States	1,017
France	19
Japan	30
England	15
China	16
Italy	5
Canada	13
Australia	2
Spain	1
Holland	2
Czechoslovakia	1
Federal Republic of Germany	9
India	9
Indonesia	4
European Space Bureau	22
International Communications Satellite Organization	33
NATO	6
France-Federal Republic of Germany	2
Eastern Europe-Soviet Union	22
Total	3,239

Table 2. Expenditures and Results of Space Activity in the World's Major Countries and Europe

Country and organization:	Soviet Union
Expenditure ($100 million):	2,000 (1961-1983)
No of spacecraft launched:	2,011 (1957-1984)
Launch vehicles:	6 types
Launch centers:	Three primary launch centers: Baykonur, Plesetsk, and Kapustin Yar.
Primary space activity and results:	In 1957 the first artificial satellite was launched. The first man-in-space flight was in 1961. In 1966 the first photos of the moon's surface were obtained. In 1957 the first photos of Venus were obtained. They launched communications satellites, direct broadcast satellite, meteorological satellites, long-term manned orbiting space station, automated cargo spacecraft for orbiting space station, remote sensing satellites, spy and intercept satellites, and planetary probes. The Soviet Union carries out an average of two launches per week.
Country and organization:	United States
Expenditure ($100 million):	1,400 (1961-1983)
No of spacecraft launched:	1,017 (1958-1984)
Launch vehicles:	There are 4 types, which they plan to replace in the future with the space shuttle.
Launch centers:	Three types: Cape Canaveral, Vandenberg, and Wallops Island.
Primary space activity and results:	In 1966 the first orbit rendezvous was carried out. In 1969 astronauts landed on the moon for the first time. In 1981 the first flight of a reusable manned spacecraft was carried out. In 1960 the first weather satellite was launched. In 1964 the first geostationary communications satellite was launched. In 1976 the first photos of Mars were obtained. In 1983 the first satellite photos of Venus, Mercury, Jupiter, and Saturn were obtained. In 1983 a probe left the solar system and military space vehicles were launched.

Country and organization:	Europe
Expenditure ($100 million):	110 (1961-1983)
No of spacecraft launched:	82 (1962-1984)
Launch vehicles:	Four types of Ariane launch vehicles are planned.
Launch centers:	The primary launch site is in French Guiana.
Primary space activity and results:	The 82 space vehicles were launched by launch vehicles of the following countries and organizations: France (13), European Space Agency (18), England (1), United States (46), Soviet Union (4). In 1965 France had the capability to put a satellite in orbit (from Nammaguir, Longhala, and the Kouyou launch site in Guiana). England plans to launch a satellite from Woomera, Australia. The European Space Agency also participated in research on aerospace vehicles space laboratory components.
Country and organization:	Japan
Expenditure ($100 million):	43 (1961-1983)
No of spacecraft launched:	30 (1970-1984)
Launch vehicles:	Three types
Launch centers:	Two launch centers: Kagoshima and Tanegashima.
Primary space activity and results:	The Institute of Space and Astronautical Sciences has developed scientific space flight vehicles to study the ionosphere, the sun, and outer space. Space development enterprise plans to invest in development of meteorological, communications and direct broadcast satellites. Three satellites were launched by the United States.
Country and organization:	India
Expenditure ($100 million):	9.5 (1961-1983)
No of spacecraft launched:	9
Launch vehicles:	Two types
Launch centers:	One launch site on Sriharikota Island.
Primary space activity and results:	Of the 9 satellites, 3 were launched by the Soviet Union, 2 by the United States, and 1 by the European Space Agency. Priority launch projects are in applications satellites, including communications satellites, weather satellites, remote sensing satellites and direct broadcast satellites, with the direction being based on projects determined on the basis of existing technology. First launched a multi-use satellite system called India Satellite-1.

Country and organization:	Canada
Expenditure ($100 million):	7 (1961-1983)
No of spacecraft launched:	13 (1962-1984)
Launch vehicles:	--
Launch centers:	--
Primary space activity and results:	Most interested in communications satellites, television broadcasting satellites, and satellites to study the ionosphere. Launched one commercially used satellite communications system, tested a maximum power communications satellite; satellites all launched by the Aerospace Bureau.

Note: No of spacecraft launched counts only spacecraft successfully launched.

In 1956 China made development of delivery technology part of the nation's 12-year development plan for science. According to the policy "We also should become involved in artificial satellites," in 1958 the launch of such a satellite was made a key state development project, and at the same time a large group of research and development projects on new materials, electronic components, instruments and gauges, precision machines and special equipment were planned.

The Chinese Academy of Sciences, the former Seventh Ministry of Machine-Building and the Fourth Ministry of Machine-Building were responsible for research and development of satellite bodies, launch vehicles and surface monitoring, tracking and remote control systems, respectively. Military medical schools began aerospace medicine research. Later, the Chinese Academy of Space Technology's Shanghai Satellite Carrier Research Base and the Chinese Academy of Science's Space Center were established. At the same time, spacecraft launch sites, telemetry centers and monitoring stations also were established and improved and formed a preliminary aerospace engineering system. On 24 April 1970, China launched its first satellite--the Dongfanghong [East-Is-Red] No 1 into earth orbit.

Subsequently, the State Council reorganized the above structure and its missions and made it clear that satellites and launch vehicles were to be developed by the Ministry of Aerospace Industry. The Commission of Science, Technology and Industry for National Defense and related departments specifically organized and managed development work on aerospace technology.

From 1981 to 1985, the emphasis was on development and construction of satellite communications projects. On 8 April 1984, the "Dongfanghong No 2" experimental communications satellite was successfully launched and achieved a major breakthrough in technology.

During this period, China actively launched international cooperation in aerospace technology, signing cooperative agreements with the governments of the Federal Republic of Germany, Italy, England, and France and drew up some cooperative project plans. China has sent technical personnel abroad for observation and advanced study, has carried out scholarly exchanges, expanded international contacts and has begun to enter international markets.

2. Important Accomplishments

After 20 years of effort, China's aerospace enterprise has formed a preliminary, complete system, trained a corps, and formed a national coordinated network. Technologically we have made great progress and are now moving toward making the transition to the stage of practical use and have laid a foundation for future development.

1) Three launch vehicles have been successfully developed and used (see Table 3). The large booster launched in May 1980 over the Pacific Ocean was completely successful, and the test communications satellite which was launched in April 1984 was successful, pushing China's launch vehicle development technology into a new developmental stage and in some areas we have reached or are drawing close to world advanced level.

Table 3. Overview of Launch Vehicles Put Into Use by China

Name	No of stages	Fuel	Payload capability
Long March No 1	3	Stages 1-2: Unsymmetrical dimethylhydrazine and nitrogen tetroxide Stage 3: solid fuel	Low-earth orbit 300 kg
Long March No 2	2	Unsymmetrical dimethylhydrazine and nitrogen tetroxide	Low-earth orbit 2,000 kg
Long March No 3	3	Stages 1-2: Unsymmetrical dimethylhydrazine and nitrogen tetroxide Stage 3: Liquid hydrogen and liquid oxygen	Transfer orbit 1,400 kg

2) Eighteen satellites have been successfully developed and launched (see Table 4). At the same time, we have expanded exploratory researches on manned space flight medicine and engineering technology.

3) The Xichang, Sichuan, Synchronous Satellite Launch Center and the Jiuquan, Gansu, Satellite Launch Center have been built.

4) A satellite tracking network has been created consisting of a number of fixed and mobile stations, two oceangoing survey vessels and the Xi'an, Shaanxi, Telemetry Center. Our geosynchronous orbiting satellite telemetry ranks with advanced world standards.

5) Satellite applications have been effective. Valuable data has been obtained in such areas as cosmic rays, geomagnetic fields, ionosphere, atmospheric density, solar X-rays, particle radiation, infrared radiation, and space physics. They have provided valuable information for land resources surveys, geological and hydrological surveys, mineral deposit exploration, forestry monitoring, agricultural and forestry, water

conservancy, communications, earth and coastal zone mapping and for engineering projects in such areas as ports, railways and cities. China's communications satellites are responsible for relaying some television programs and communications. In addition, we use several hundred earth stations which we produced ourselves and have obtained excellent results through renting Intelsat No 5 for boradcasting television.

6) Progress in aerospace technology has spurred on developments in many industries, such as metallurgy, chemicals, electronics, and materials.

Table 4. Eighteen Satellites Launched by China (1970-1986)

No	Satellite name	Launch time	Application
1	Dongfanghong No 1	1970.4.24	Carried out science and technology experiments. Satellite weighed 173 kg. China is the fifth country in the world to independently launch a satellite.
2	Shiyan No 1	1971.3.3	Carried out space physics tests. Satellite weighed 221 kg.
3	Scientific probe and technological experiment satellite 1	1975.7.26	Carried out engineering technology experiments.
4	Scientific probe and technological experiment satellite 2	1975.11.26	Recovered after 3 days' operation. China became the third country in the world to master satellite recovery technology.
5	Scientific probe and technological experiment satellite 3	1975.12.16	Carried out remote sensing technology testing.
6	Scientific probe and technological experiment satellite 4	1976.8.30	Carried out remote sensing technology testing.
7	Scientific probe and technological experiment satellite 5	1976.12.7	Remote sensing technology testing. Recovered after 3 days' operation.
8	Scientific probe and technological experiment satellite 6	1978.1.26	Remote sensing technology testing. Recovered after 3 days' operation.

No	Satellite name	Launch time	Application
9	Shijian No 2	1981.9.20	Space physics tests. Three satellites launched by a single booster.
10	Shijian No 3	1981.9.20	
11	Shijian No 4	1981.9.20	
12	Scientific probe and technological experiment satellite 7	1982.9.9	Carried out tests of new technology. Satellite recovered after 5 days' operation.
13	Scientific probe and technological experiment satellite 8	1983.8.19	Carried out tests of new technology. Satellite recovered after 5 days' operation.
14	Dongfanghong No 2-1	1984.1.29	Carried out communications technology experiments.
15	Dongfanghong No 2-2	1984.4.8	Carried out communications technology experiments, stationary orbit.
16	Scientific probe and technological experiment satellite 9	1984.9.12	Carried out tests of remote sensing technology. Satellite recovered after 5 days' operation.
17	Scientific probe satellite	1985.10.21	Carried out tests of remote sensing technology. Satellite recovered after 5 days' operation.
18	Dongfanghong No 3	1986.2.1	Carried out tests of remote sensing technology. Satellite recovered after 5 days' operation.

3. Seventh Five-Year Plan Plans and Policies

During the Seventh Five-Year Plan we will develop many satellites and carrier rockets. For launch and telemetry systems we will approach the international market.

For the Seventh Five-Year Plan period, we will adopt mainly the following policies: 1) Actively develop aerospace technology and make it one of the key points in development of new technology. 2) Give priority to development of communications, weather, and resource satellites and key breakthroughs which have a major impact on national economic construction. Strive for multiple and comprehensive use of a satellite. Each launch should have benefits in many areas. 3) In both organization and management we should continue to implement the principles of integration of military and civilian focus on leadership, unified planning, rational division of labor, and stress cooperation. 4) On the basis of self-reliance, actively develop a variety of forms and a variety of channels for international cooperation and technological

exchange. 5) Actively provide aerospace technology commercial service for other countries in the world. 6) Technologically, we should strengthen basic research and applied research with a view to developing in the direction of reliability, longevity, high capacity, and multiple functions to lay a foundation for future development.

Section 8. Remote Sensing Technology

Remote sensing technology is a new technology which developed very rapidly in the sixties. Currently, this technology is widely used in such areas as agriculture and forestries, geology and geography, marine hydrology, environmental monitoring, mapping and weather forecasting, and has played an important role.

1. Trends Abroad

Remote sensing has gone through the two stages of aeronautical and aerospace remote sensing. In future it will develop toward the stage of intelligence.

1) Since 1969, the United States has successfully launched weather satellites, ground satellites, marine satellites and a variety of manned spacecraft, and at the end of 1981 in particular began a series of space shuttle tests. While actively developing their own space remote sensing technology, France, the Federal Republic of Germany, Japan, the Soviet Union, Canada, and India created a very competitive situation.

2) For a long time, camera systems have been the primary technique for obtaining remote sensing data. The development of multistage scanning systems and imaging radar systems has been the most active technological area. Currently, the development of satellite-borne scanners has entered the third generation and uses CCD series matrix detectors. Synthetic aperture imaging radar has already made the transition from aircraft-borne to satellite-borne and is developing in the direction of multiple frequencies, multi-polarities and multiple viewing angles.

3) The introduction of a new generation of transducers spurred on the accelerated development of new remote sensing data processing systems. Important development trends in processing systems are 1) high speed and large capacity and 2) remote sensing image reading specialist systems and comprehensive analytical methods supported by geographical information systems.

4) Remote sensing applications are now making the transition from analytical application of sensed data from a single transducer toward multiple transducer, multistage, multiple time-images and comprehensive analysis application of auxiliary data; making the transition from static analysis research of resources and the environment toward monitoring of dynamic processes; making the transition from qualitative survey mapping of resources and the environment toward quantitative evaluation forecasting; making the transition from describing surface phenomena of crops and processes toward exploring their inherent laws.

2. Developments in China

In the late fifties China began to use aerial photography to carry out such tasks as survey mapping, forestry surveys, geological surveys, water resources exploration, and selection of railway routes and supplied a great deal of basic data and maps for economic construction. Beginning in the early seventies, expanded applications and research on satellite remote sensing and aeronautical remote sensing have been carried out.

1) A remote sensing specialist corps of upper level scientific and technical personnel numbering over 3,000 has taken shape and there are nearly 180 scientific research and production units. The National Remote Sensing Center is responsible for such missions as setting China's remote sensing development principles and policies, formulating national remote sensing development plans, coordinating remote sensing forces in all departments nationwide, setting up attacks on technological key problems on projects urgently needed by the state, and promoting international exchanges and cooperation. In addition, 15 specialized remote sensing centers have been established nationwide.

2) China has the capability to launch man-made earth satellites of different types. Currently scientific experiment satellites, weather satellites, and earth resources satellites are being actively developed. Clear progress has been made in China's medium and low altitude remote sensing data acquisitions technology systems, especially development of airborne transducers. There has also been significant progress in the development of various types of remote sensing image processing systems.

3) During the Sixth Five-Year Plan China approved the establishment of two surface stations, ground satellite and weather satellite, and the establishment of the two stations created a capability for providing dynamic satellite remote sensing data in real-time and with the addition of imported high altitude remote sensing data acquisition systems and medium and low altitude remote sensing aircraft, an improved multilevel operations system was formed.

4) Remote sensing technology is rather broadly applied in various departments in China, has had preliminary success, and a great deal of useful experience has been accumulated. Research and development of resources and environment information systems and the establishment of some corresponding experimental and practical information systems are also under way.

During the Seventh Five-Year Plan, the primary task of China's remote sensing technology will be on the foundation laid by the Sixth Five-Year Plan to further the in-depth development of technology and push applications research in the direction of practical transformation; to convert its inherent capability into powerful productive forces, form industries, and create more social and economic benefits. For this reason, we must first stress certain remote sensing applications projects which are urgently needed for economic construction, actively expand remote sensing data acquisition, comprehensive analytical process of a variety of remote sensing data, and experimental research on resource and environmental information systems.

3. Basic Policies for China's Development of Remote Sensing Technology

1) Oriented toward applications and economic construction. We should vigorously support remote sensing applications projects which are intimately related to national economic construction and have clear benefits, such as national resource surveys, dynamic monitoring of resources and the environment, site selection and evaluation of large-scale engineering projects, and management of regional development and urban planning.

2) Unified planning, coordination of division of labor. On the basis of fully mobilizing research, formulate national remote sensing technology short-range and long-range development plans. Under the guidance of unified national planning, fully mobilize the initiative of departments and districts, concentrate manpower, material, and finances to attack key problems in coordination.

3) On the basis of self-reliance, strengthen international exchanges and cooperation, and accelerate the development of China's remote sensing technology by such techniques as sending personnal abroad for advanced study, inviting foreign specialists to lecture, developing cooperative research, and importing key equipment.

4) Combine organically remote sensing applications research and basic research, strive for breakthroughs in such research areas as geophysical spectrum characteristics and atmospheric transmission characteristics, and principles and methods of remote sensing data analysis.

5) Strengthen training of remote sensing technical and applications personnel. Continue to improve the quality of China's remote sensing experts corps by recruiting graduate students, on-the-job training, and sending students abroad for study and train a generation of researchers with ability to conduct research in many sciences and comprehensive management talent.

Section 9. Laser Technology

Laser technology is a new technology which developed rapidly after the appearance of the first laser in 1960. Currently, the operating wave band of lasers in the short wave area has expanded to ultra-violet and vacuum ultra-violet and all the way to soft X-rays and in the long wave area has expanded to near infrared and far infrared and all the way to the millimeter wave band. The maximum output power of continuous lasers has reached several thousand watts, the peak power of pulse lasers has reached 100 megamega watts, and the pulse width can be as narrow as 10 femtoseconds.

In the past 20 years, there have been significant developments in China's laser technology. There are over 40 institutes and laboratories under the Chinese Academy of Sciences and the Central Ministries and Committees, over 30 institutes and laboratories of provinces, municipalities, and regions, over 70 institutions of higher learning have established laser specialties or research laboratories, and approximately 200 factories have begun

developing laser applications and producing products. Nationwide there are approximately 10,000 persons involved in laser work of which approximately one-third are scientists and technicians.

China has developed a variety of types of lasers. Annual production of helium-neon lasers has reached 15,000 units. Series production has taken shape, and carbon dioxide lasers, argon ion lasers, Nd-doped yttrium aluminum garnet lasers, ruby lasers, neodymium glass lasers and tunable dye lasers are already in batch production.

In terms of industrial applications of lasers, by the end of 1981, 480 scientific research results had been obtained, of which approximately half are now in use. Lasers have been applied in drilling of clock and watch parts, micro-welding of special components, digitally controlled laser cutting, hardening of metal surfaces, and laser alignment guiding. Nationwide, important measurement departments have established laser length measurement systems. Laser range-finding has played a role in exploration, mapping, and traffic engineering construction. According to 1982 statistics, China has over 30 types of laser industrial application products.

In the area of optical fiber communication, China has basically mastered application technology of optical fibers in circuits between municipal telephone bureaus, and low speed, small capacity, short distance multimode optical fiber communication technology has reached the initial levels of use.

China has formed an initial network of laser satellite range-finders it developed itself.

The high stable frequency helium-neon laser which China developed itself has met advanced standards.

In the area of lasers in medicine, China is one of the few countries in the world to be the first to undertake clinical experimentation with lasers, the diseases treated and the number of persons who have undergone treatment is rather remarkable, and they have been highly respected and valued internationally. According to initial statistics, China has over 200 medical treatment units using lasers, over 200 diseases have been treated, approximately 1 million patients have been treated with very satisfactory results and a total of over 1,500 laser treatment and diagnostic devices have been produced.

In terms of powerful lasers, in the late seventies China established a 6-circuit neodymium glass laser system, with pulse power of 200,000 megawatts. We are currently building a new phosphate glass laser with even more power.

Much basic research and some applications research in such areas as laser spectroscopy, non-linear optics, laser chemistry, and laser biology are under way in many institutes of the Chinese Academy of Sciences and institutions of higher learning.

During the Seventh Five-Year Plan, the development of laser technology will continue to be one of the key national science and technology projects.

In the future we should further improve the stability and reliability of ordinary lasers and undertake research on new lasers as a key project. For this, we should improve the product development capability of relevant research agencies and factories, we should give full attention to development of research on materials, components, test equipment and key component technology, and continue to arrange for national product quality testing, measurement and appraisal to spur on improvements in product quality.

We should continue to place importance on research and development of laser applications, the key areas of which are laser processing, laser detection, optical fiber communication, optical storage technology and military lasers. In view of the fact that the area of laser technology applications is very broad, we should encourage research and development units and applications units to establish direct contacts, sign lateral contracts, open new fund channels to make it possible for projects which are not key project areas but which have applications prospects to be suitably arranged.

Because there are intimate inherent connections between scientific research on lasers and the development of laser technology, it is necessary to place great stress on basic research work to develop laser technology and its applications.

Section 10. Isotope and Radiation Technology

Isotope and radiation technology is an important part of nuclear science and technology. It is the foundation of nuclear science and technology and a new technology combined with other technologies. It mainly includes: radiation processing technology, nuclear detection and analysis technology, isotope tracer technology, and radiation chemistry, nuclear medicine, and nuclear agronomy.

Isotope and radiation technology is broadly applied, has clear benefits and is regarded highly by countries universally. Between 1960 and 1985 the cumulative investment in isotope and radiation technology worldwide was $7.7 billion, and the cumulative economic benefits were about $80 billion.

The application of isotope and radiation technology achieved success first in medicine, then it was extended to industrial and agricultural sectors. For the past 30 years, isotope and radiation technology has been broadly applied in industry, agriculture, medicine and scientific research.

Isotope and radiation technology applications research began in the early period of the development of nuclear energy in China. In the 20-year science and technology development plan formulated in 1956, isotope technology applications research and extension was made an important aspect of the peaceful use of atomic energy. In 1981, the party Central Committee decided to shift the direction of atomic energy key emphasis to service to the national economy and the standard of living. Thus, the development of

isotope and radiation technology entered a new period. The development of isotope and radiation technology has generally gone through three periods: the creation stage, the applications research stage, and the industrial applications stage (see Table 1).

Table 1. Major Events in China's Development of Isotope Technology (Not Including Taiwan and Hong Kong)

Year	Major event
1956	Isotope application research made part of the 20-year plan for the development of science and technology.
1959	The Isotope Application Committee of the Atomic and Nuclear Science Committee of the Chinese Academy of Sciences established. The first experimental research reactor and cyclotron go into operation. The first radioactive isotopes go into production, a total of 33 types.
1960	Zhou Enlai personally approves a special appropriation of foreign exchange for the importation of isotope products.
1961	The State Science and Technology Commission established the Eighth Bureau (simultaneously the Second Machine Ministry exercised dual leadership), responsible for organizing and coordinating work on research on the peaceful uses of atomic energy, although the agency was reorganized and changed, organization and coordination of isotope technology research was always a mission of the State Science and Technology Commission.
1963	The National Radio-Biology and Radio-Medicine Conference and the First National Radio-Chemistry Conference were convened.
1964	National Conference on Isotope Application in Agriculture and Biology convened.
1965	First radio-chemistry intermediate experimental base construction begins in Jilin.
1967	Institute of Atomic Energy constructs a production line for manufacturing radioactive isotopes.
1971	Domestically self-produced isotope products reach 136 types, primary reliance on importing isotope products ends.
1972	Radioactive Isotope and Ray Applications Exhibition and Experience Exchange Conference held in Beijing.
1973	State Council approves creation of radioactive isotope production and application leadership group.

Year	Major event
1977	National Radioactive Isotope Application Technology Conference held in Harbin, First National Special Conference on Irradiation Preservation of Food held in Chengdu.
1979	Chinese Atomic Energy Agriculture Society established. Chinese isotope delegation participates in 10th Japan Radioactive Isotope Conference, international technological exchanges begin.
1980	China Nuclear Society established, subsequently the China Nuclear Medicine Society, China Radiation Research and Radiation Technology Society, Particle Accelerator Society, and China Isotope Society established under the Nuclear Society.
1981	Central Committee approves the direction of shifting the key emphasis of atomic energy to the national economy and domestic use while ensuring military use.
1982	National Isotope Conference convened in Beijing jointly by the State Science and Technology Commission, the China Science Association, and the Ministry of Nuclear Industry; isotopes and radiation technology are new technology included in the key project plan of the State Sixth Five-Year Plan, a total of 25 projects.
1983	National Atomic Nuclear Science Technology Application Exhibition held in Beijing.
1984	China joins the International Atomic Energy Agency. Ministry of Public Health formally approves the public health standards for irradiation preservation of potatoes, onions, garlic, grain, mushrooms, and provisional public health standards for sausage.

At present, in terms of research agencies, personnel and equipment, there is a definite foundation and scale. There are more than 10,000 experts and technicians engaged in research, and nearly 40 specialized research agencies. There is a total of 8 atomic reactors, 135 low energy accelerators, and 30 Cobalt-60 radiation devices above 10,000 curies. Nationwide China can produce over 600 isotope products and commonly used nuclear instruments can be produced. The main achievements in applications research are: agriculturally, radiation method and other methods have been combined to cultivate 194 new varieties of agricultural crops. In medicine, over 800 treatment and public health units nationwide use isotope technology and clinically, over 100 isotope methods have been established. In industry, over 3,500 detection instruments are in use, well testing technology is universally used in oil and coal development, and over 10 radiation chemical industry products are in small batch production. The state has announced public health standards for irradiation preservation of 7 food products: grains, potatoes, onions, garlic, mushrooms, peanuts, and sausage; in scientific research, the application of nuclear analysis technology and tracer technology have secured a great quantity of valuable material which has played an important role. However, there

are still some questions such as, the deficiencies in equipment and conditions, the level of technology is low, and applications are not sufficiently extended, the gap with foreign countries is big (see Table 2) nor can it adapt to the demands of the four modernizations.

Table 2. Comparison of China's Isotope Technology Development Levels and Foreign Advanced Levels

Indicator	Industrially developed countries of the world	China
Starting date	U.S.: 1946 Soviet Union: 1948	1956
No of persons engaged in field	U.S. 1978: 183,000	120,000 (scientists and technicians)
No of users	Over 10,000	2,000
Industrial use ratio	38% (Japan)	7.5%
No of research reactors (units)	227 (U.S.) 23 (Soviet Union)	8 (including 1 high-flux reactor and 2 production reactors)
Low power accelerators (units)	Over 2,000 (U.S.) 700 (Japan)	135
No of Co-60 radiation sources	120 (worldwide, 100 million curies)	30 (ca. 1 million curies)
Varieties of isotope products	3,800 (worldwide)	
Output value ($US)	Nearly $1 billion	Nearly 11 million (yuan)
Output value of radio-chemistry industry products	$2.8 (U.S., 1985)	5 million (yuan)
No of isotope instruments	200,000 (U.S.) 80,000 (Soviet Union)	3,500
No of varieties (agricultural crops) radiation cultivated	518 (worldwide)	194
Varieties of approved irradiated foods	More than 40 (26 countries)	7

During the Sixth Five-Year Plan, 25 key projects were arranged for the development of isotope and radiation technology. During the Seventh Five-Year Plan, we will more fully exploit the strong points of isotope and radiation technology, closely combine it with the needs of national economic development, actively organize developmental research, and obtain clearer socioeconomic benefits. For this reason, in addition to requiring special state investment, we will actively give rein to the strength of production departments and local and grass-roots level units and more effectively develop projects which directly serve production. We will mainly do three things: First, organize development research, concentrate forces, make key project breakthroughs, and apply mature domestic technology as rapidly as possible within China. For example: nuclear spectroscopy well technology, on-line analysis technology, radiation modification of polymers, irradiation preservation of foods, and irradiation sterilization of articles used in medical treatment. Second, strengthen foundation work to improve weak links. The most important things are resolving the problems of the high power accelerator technology used in radiation and isotope preparation technology which are in short supply and urgently needed. Third, vigorously extend the results of scientific research to use it in production as quickly as possible and convert it into productive forces. In addition to developing further the application and extension of isotopes and radiation technology in agriculture and medicine, we should also stress extension to industrial applications.

8226/6091
CSO: 4008/7

CHAPTER 5. THE 'SPARK PLAN'

[Text] Since 1978, the CPC's rural economic policy has demonstrated its power. Throughout China's vast countryside, reform has blossomed, producing a bumper crop of achievements. Today, the great transformation of the nation's rural structure has begun, marking another major step in rural economic reform. To accomplish this magnificent undertaking, we must rely on scientific progress to accelerate the development of ownership and township enterprises. That is why a glorious and arduous task facing us now is to put science and technology to work to vitalize township enterprises and propel rural economic development. It is this consideration that prompted the State Science and Technology Commission to propose the "Spark Plan."

(1)

The birth of the "Spark Plan" is no accident. It is based on a massive amount of social experience, studies, and analysis and meets an urgent demand in rural economic development in China.

Over the past 4 years, township enterprises have been springing up like mushrooms across the vast countryside, displaying a rare vitality. They have become a force that cannot be ignored in the national economy, particularly local economies. According to statistics, the output value of township enterprises reached 170.9 billion yuan in 1984, more than 17 percent of the nation's gross value of industrial and agricultural output. They earned 18.74 billion yuan in net profits and paid 9.06 billion yuan in taxes. In provinces like Jiangsu and Zhejiang and other more developed places, the output value of township enterprises already accounts for 50 to 70 percent of the gross value of agricultural and industrial output of their respective localities. In 1985, township enterprises chalked up an even faster growth rate, with output value topping 230 billion yuan, almost 20 percent of the nation's gross value of industrial and agricultural output, and approaching 30 percent of China's gross value of industrial output. If their output value expands 10 percent each year in the future, it will exceed 1 trillion yuan by the year 2000, or one-third of China's gross value of industrial and agricultural output. We can thus see that township enterprises are a pivotal pillar in the nation's economy and a vital new force in its drive to quadruple the gross value of industrial and agricultural output to 2.8 trillion yuan by the end of the century.

The development of township enterprises has other profound strategic significance.

1. It offers a solution to settling the problem of a surplus rural labor force.

For years now, China has drawn up numerous policies to restrict the unplanned influx of rural population into the cities. It has also set up many labor-intensive industries to provide jobs for the labor force. But the problem has not been resolved. Following the Third Plenum of the 11th CPC Central Committee, because of rising agricultural labor productivity, the rural surplus labor force has further increased. Currently the nation's rural labor force consists of 360 million people. In the early liberation days, a rural laborer worked 9 mu of arable land on the average. Today the figure has dropped to 4.5 mu. Moreover, there is now 180 x 10^6 kW of agricultural machinery all over China, equivalent to 700 to 800 million workers, which only exacerbates the oversupply of rural labor. Even if rural areas diversify economically, there will still be a vast army of surplus unemployed workers. Now the development of township enterprises has provided a solution. According to late 1984 data, employment at such enterprises had already topped 50 million. The addition of one worker to industry in the publicly-owned economy requires the state to increase investments in fixed assets by 14,000 yuan. Thus to provide jobs for 50 million people necessitates additional state investments in fixed assets to the tune of 700 billion yuan. Furthermore, the addition of one worker and his dependents to the urban population costs the government 10,000 yuan in outlays on housing, administration, and public facilities. Add the two kinds of expenditures, and the state will wind up with a 1.2 trillion yuan bill as a result of 50 million peasants entering the cities to take up jobs. There is just no way the government can make that kind of investment in the short run. But now we have hit upon the development of township enterprises as a way out, solving the employment problems of 50 million people. In 1984 alone, township enterprises achieved an output value of 170 billion yuan. Not only have they spurred economic growth and increased peasant earnings, but they have also been instrumental in ensuring social stability. That is no mean feat.

2. Acquire useful experience to help China's search for an approach to rural modernization.

In the past when we followed the principle, "take grain as the key link," even high-yield areas failed to lift themselves from poverty, not to mention achieve modernization. Today rural areas are diversifying extensively and developing township enterprises. As a result, the rural economic base has been strengthened and the peasants have cash as well as grain at their disposal. Thus equipped for investment and reinvestment, they can now purchase fertilizer and go in for mechanization and irrigation. With "industry subsidizing agriculture" this way, farming has been able to grow even faster.

In the course of industrialization, nations all over the world inevitably underwent urbanization. This is because many public facilities and the industrial infrastructure must be provided in a centralized manner; water

supply, heating, gas supply, roads, and transportation all require centralized operation and management. The development of myriad small towns distributed across the nation constitutes exactly an important approach to urbanization in China. In addition, the development of small towns must rely on township enterprises. Therefore the development of township enterprises is indispensable for rural modernization and urbanization.

3. The transformation of old and large cities cannot take place without the support of township enterprises.

A number of old cities such as Shanghai and Tianjian are overgrown. With their high-density concentration of industry and serious pollution, they must be transformed. A crucial transformation measure is to hive off a substantial number of traditional operations to township enterprises, freeing the cities to gradually become technology-intensive industrial centers. For instance, 80 to 90 percent of the parts and components of several brand-name home electric appliances produced in Suzhou are now made by township enterprises. The development of these enterprises may yet present a way whereby the gaps between industry and agriculture and between urban and rural areas can be narrowed or bridged in a manner compatible with Chinese conditions.

Township enterprises brim with vitality. While their labor productivity is lower than that of modernized enterprises, it exceeds agricultural productivity by far. Besides, the improvement of labor productivity is a gradual process; the transition from crop cultivation to manufacturing is an improvement in itself. The development of township enterprises has also resulted in significantly better agricultural production conditions. Moreover, judged by some criteria, their economic results are not at all inferior to those of large state-run enterprises. Statistics show that nationwide every 100 yuan invested in fixed assets in industry above the county level yields 91 yuan in output value. The corresponding figure for township enterprises is 229 yuan. High output value is accompanied by equally high profits and tax payments. In 1984, state-owned industry and township enterprises paid 22 yuan and 34 yuan, respectively, in taxes for every 100 yuan invested in fixed assets. In the same year, national revenues rose about 15 billion yuan, of which 20 percent came from township enterprises. Certainly these enterprises consume energy. At the same time, they also produce energy. Over the past 4 years, coal output grew by 150 million tons, including 110 million tons from small coal pits, which have played a key role in relieving the shortage of energy supplies. Township enterprises similarly contribute to the building materials industry, producing 53 percent of cement and sand aggregates. In many ways township enterprises provide large industries with the raw materials for primary processing as well as some parts and components. In this sense they are an indispensable supplement to large state-owned industries.

There are aspects in production management where township enterprises are backward, but there are also areas where they display their unique vigor. Most of them have emerged from competition in a market economy and must secure raw materials and energy on their own. With their low management costs and lean management staff, they have brought together production, supply, and marketing under one roof and made themselves highly adaptable.

With their manifold advantages, township enterprises have taken root in the fertile soil of China's countryside, reaching maturity as they steadily absorb nutrients. A trend has appeared in the world nowadays toward the development of numerous small and specialized modern factories. They can be found in the United States, Japan, the Federal Republic of Germany, Britain, Italy, France, and a number of developing nations. The growth of township enterprises conforms with this trend.

China has 800 million peasants. Without improving their mode of production and way of life, socialist modernization and the vitalization of the entire nation will be out of the question. The lack of knowledge, backward science and technology, low productivity--such are the major reasons why China's extensive rural areas have so far failed to lift themselves from poverty completely. Only guided by the correct policies of the CPC Central Committee and by relying on science and technology can we embark on the broad avenue toward prosperity. It is against this backdrop that the "Spark Plan" emerged. Its mission is to disseminate advanced and applicable science and technology among township enterprises and spread it throughout countless villages.

Since it was proposed, the "Spark Plan" has been regarded as a priority by the CPC Central Committee and the State Council. Comrade Zhao Ziyang pointed out: "This undertaking has both practical and far-reaching significance. We cannot transform the agricultural structure without developing township enterprises. But any effort to develop township enterprises will be doomed if we do not rely on science and technology. By combining the two, we may forge a path that suits China's conditions. If we pursue the 'Spark Plan' as a cardinal policy on a long-term basis, we will certainly be rewarded with unexpected achievements."

The "Spark Plan" is immensely popular everywhere and has drawn an enthusiastic response among the broad masses of scientific and technical personnel, firing their desire to contribute even more to their local economies and bolstering their initiative in serving township enterprises. Today these personnal have swung into action on their own. The "Spark Plan" opens up a new vista in making full use of the intelligence and expertise of intellectuals.

The CPC Central Committee and State Council have authorized the State Science and Technology Commission to implement the "Spark Plan." It is an important component of China's science and technology and national economic plans. That science and technology should serve local economies and that the latter should depend on the former is the only way to achieve vitalization at the local level.

(2)

Guiding objectives for the "Spark Plan" during the Seventh Five-Year Plan are as follows: 1) develop 100 complete sets of technology and equipment suitable for township enterprises and organize their mass production; 2) establish 500 township enterprises as technical prototypes, and furnish them with technology and processes, management procedures, product design and

quality control techniques; 3) provide short-term training for 1 million working young intellectuals and grass-roots cadres to equip them with one or two pieces of advanced technology applicable to where they are; 4) carry out regional development in 12 mountainous areas, coastal, and low- and medium-yield areas; and 5) promote the establishment of a number of export production bases and nonstaple foodstuff bases. Each year during the Seventh Five-Year Plan, the state will support the "Spark Plan" with definite amounts of grants, special bank loans, and a small quantity of foreign exchange.

To bring the "Spark Plan" more in line with realities and make it more flexible, the government decided against long-term planning and opted instead for 2-year plans. In addition, the plan will be reviewed annually on a revolving basis to be amended, substantiated, and generally improved.

Accordingly, the State Science and Technology Commission has drawn up a "Spark Plan Implementation Program for 1986-87" jointly with the provinces, autonomous regions, municipalities directly under the central government, cities with province-level economic decisionmaking authority, relevant ministries and commissions under the State Council, the Chinese Academy of Sciences, and the Chinese Science Association. Incorporated in the program are 736 projects to be financed and supported by the state and 51 training points. They can be classified into the following 10 categories.

1. Modern Livestock Industry and the Preservation, Storage, and Transportation of Its Products. The Development of Technology for Processing at Points of Origin.

The top priority in the current drive to transform the rural structure is to turn the traditional family business of raising livestock into a modern, large-scale, commercialized livestock industry. It requires relatively little capital and can be started and operated easily. Thus it can absorb some of the rural surplus labor force in a relatively short period of time. It will help upgrade food products and increase their added value, boosting the development of crop cultivation. It can increase the output of animal protein, thereby improving the diet of urban and rural residents. It can also supply raw materials like skin, down, feathers, meat, blood, and bones for secondary processing, in the process laying the groundwork for a string of new industries such as storage, transportation, and processing. The key technical requirements for effecting the change from family business to commercialized operations are: develop factory-type livestock technology and facilities that are capital and energy-efficient; select and breed the finest breeds; develop new feeds; set up a disease control system; adapt new packaging; and develop small and medium-sized storage, transportation, slaughtering, carving, and processing technology. Over the next 2 or 3 years, we should concentrate on designing for the localities a complete line of technology which is suited to their individual markets and basic conditions, carrying out demonstration projects, providing the accessory equipment and technology, and propelling the vast countryside toward gradually establishing the above new industry. Among major technologies to be developed are:

1) The fast fattening of cattle and sheep. This includes the use of industrial waste, straw treatment, growth hormones, fattening technology, the technology of utilizing grassy hills and slopes, improving the kidding rate of ewes, and selecting the best cross-breeding combination.

2) The factory breeding of fur rabbits and rabbits raised for both their fur and meat. Improving the survival rate, disease control technology and high-yield breeding technology. Simple facilities. The breeding of superior breeds. Rejuvenation and the protection of good breeds.

3) The breeding of freshwater aquatic animals. Preservation, storage, and transportation. Increasing the efficiency of fish breeding in ponds. Artificial breeding of river crabs. The use of the fish seine on large water surfaces and reservoirs. The storage and transportation of aquatic products while keeping them fresh and alive.

4) New feeds and feed additives, focusing on the development of full-price feed, feed protein, feed additives, oxytocin, binding agents.

5) The processing and utilization of pig fat.

6) Duck and goose products. The raising of poultry on small and medium-sized farms. Egg and meat processing.

7) The development of technology for the rural dairy industry.

2. The Comprehensive Utilization of Agricultural, Forestry, and Special, Native Products. Processing at Points of Origin. Preservation, Storage, and Transportation Technology.

Among industries whose raw materials are agricultural, forestry, and special, native products, some should be located near their markets for large-scale centralized production. With an eye toward improving macroeconomic benefits, however, a considerable number of them should conduct most of their processing where their raw materials are produced. These industries should preferably also operate on a small or medium scale.

As a joint undertaking, the preservation, storage, and transportation of agricultural, forestry, and native products should involve both urban and rural areas. Processing at points of origin, preservation, storage, and transportation are rural industries. In areas far away from large industrial cities, in particular, these industries are focuses of development. They are also a crucial condition for the formation of large-scale cash crop bases, the improvement of economic benefits, and modernization. The development focus of the plan is to achieve the following demonstration targets in major typical producing areas: below the county level, the quality, energy efficiency, and economic results of the simple processing of grain and oil and the complex processing of some other products should reach the highest domestic standard; by and large the byproducts of typical grain and cotton producing bases should be utilized comprehensively in a sound manner to form families of technical products. Well-known brands of native fruit are poor

in quality, the losses are high and the supply seasons too short. This should be changed. New special, native products with a market potential, such as natural essence, perfume, and pigment should be developed. Upscale high-quality beverages should also be developed. These are the primary technologies to be developed:

1) Advanced oil-refining technology involving cold water to be used by small oil factories. The refining and multiple processing of oil products. Comprehensive utilization of nigre.

2) The comprehensive utilization of cotton stalks, cottonseed, and vegetable seed. Nonpolluting small-scale plate-making technology. Paper-making technology causing pollution that can be controlled.

3) New production technology of grain and potato starch derivatives and their utilization.

4) Soybean protein separation technology and product development.

5) Sunflower seed processing and the utilization of byproducts.

6) The multiple processing of lignosa seeds. The manufacturing of cocoa oil using the seeds of Chinese tallow trees.

7) The comprehensive utilization of such rapid-growing trees as bamboo, willow, and paulownia.

8) The preparation of tannin extract, shellac, gutta-percha, and tannic acid. The utilization of byproducts.

9) The development of upscale high-quality beverages.

10) The multiple processing and comprehensive utilization of such natural fibers as cotton, silk, and flax.

11) The manufacturing of fur products and their comprehensive utilization.

12) The manufacturing of down goods.

3. Village and Town Construction. The Development of the Building Materials Industry. The Promotion of the Standardization, Commercialization, and Factory Production of Rural Housing.

With the reform of the rural economic structure and marked rise in peasant incomes, an urgent demand for improved living conditions has arisen. During the Sixth Five-Year Plan, new rural construction in the nation reached 3.8 billion square meters, which was more than the total for the preceding 30 years. In 1985, investments in rural housing and public works in villages and towns amounted to more than 45 billion yuan, and estimates are that new construction each year during the Seventh Five-Year Plan will still reach about 700 million square meters. Hence we must energetically upgrade the

technology of building materials and expedite the standardization, factory production, and commercialization of rural housing. If we succeed in village and town development, we can provide peasants with suitable, safe, economical, and attractive housing, on the one hand, and help the national treasury recoup vast sums of money, on the other. By economizing on building land, we will also be preserving land resources.

Right now, problems abound in village and town construction and rural housing development. For instance, the planned distribution of village and town construction is not rational. Rural housing suffers from low design standard, poor construction quality, and an absence of such infrastructural facilities as water supply, roads, environmental sanitation, and energy supply. Building materials, products, and equipment are limited in quantity and variety. There is also an acute shortage of technical personnel. All these problems must be gradually solved by scientific and technical progress. The major technologies to be developed are:

1) Draw up laws and regulations governing village and town planning, general design, and standards.

2) Carry out experiments in the development of comprehensive technology for rural housing construction.

Experiments are first to be launched in five test sites in the east, west, south, north, and center. Specifically, four provinces and municipalities have been picked, namely, Sichuan, Jiangsu, Beijing, and Heilongjiang, and plans are afoot to select another site in Guangdong or Fujian. These points are selected primarily to reflect the requirements of rural housing and village and town construction of different standards and at different levels. On the one hand, the various test sites should each have their own special characteristics. On the other hand, they should tackle in a comprehensive way widespread problems common to village and town construction in general, e.g., construction quality, water supply, drainage, roads, and environmental protection. A rural housing development company that offers a complete package of services--planning, design, construction, and building materials supply--should be set up at each test site to be the general contractor for design, construction, building materials supply, and consulting, among other things.

3) Building material technologies to be developed:

(1) Improve the product quality of small cement plants and lower their energy consumption.

(2) Using local resources, develop building materials for rural housing, such as non-sintering shale brick and tile, ash-sand block, small hollow cinder block, red soil non-bake brick, etc.

(3) Produce cement, hollow brick, and furring tile, using industrial waste, gangue, and fine coal ash.

(4) Use the leftover bits and pieces of agricultural byproducts to make non-rubber or low-rubber fiberboards.

(5) Develop uses for new building materials in the construction of rural housing, such as water proof roller materials, glass fiber-reinforced cement, color cement, color tiles.

4) The development of equipment for manufacturing building materials and construction machinery.

4. The Mining and Primary Processing of Minerals at Small Mines. The Development of Mineral Products Where Conditions Permit.

After the CPC Central Committee put forward the principle, "exploit big mines on a big scale, small mines on a small scale, and make use of available resources," the masses' enthusiasm for mining has risen to an unprecedented high. While the growth of small mines has been spectacular, they still mainly depend on indigenous mining and dressing methods, which are highly labor-intensive and waste resources, have a low recovery rate, and cause serious pollution. Some primary processed products are shoddy and yield poor economic results. Appropriate measures must be taken to guide the development of small mines in a sound and healthy way.

During the Seventh Five-Year Plan, based on the resource situation and market demand, it is proposed to concentrate on the development of small "nonferrous metals" such as tin, gold, copper, aluminum, and stibium to supplement the "major nonferrous metals." Turning to nonmetals, we should go after kaolin, bentonite, olivine, etc., the development of which will yield good economic results and pay off quickly. Among the major technologies to be developed are:

1) Develop small, low-cost, and highly efficient flotation plants and reflotation plants. These plants should be mobile and be able to handle 50 to 100 tons of minerals a day.

2) Develop some single pieces of equipment to increase metal recovery rate. For example, by inventing a small and compact gold panning machine which makes panning easier and is convenient to operate, we may increase the recovery rate from 45 to 75 percent.

3) Adopt appropriate advanced technology to process small nonferrous metals and precious metals.

(1) Gold. Build a small smelter where there is a concentration of small gold mines to turn gold concentrate into manufactured products.

(2) Copper. Usually found with nickel. Where large enterprises are too preoccupied with other products to pay attention to this metal, its byproducts should be processed into finished materials.

(3) Antimony white. After dressing by mobile equipment, antimony white should be produced from its concentrate.

(4) Aluminum products. Use direct electrolysis to make aluminic silicon alloy from aluminum ore.

4) Develop nonmetal products.

(1) Kaolin. The priorities here are to develop a dressing circuit and to make better products.

(2) Bentonite. Develop new production techniques to put new products on the market.

(3) Magnesium, chromium, and olivine. The focus here is on the development of new varieties.

5) Improve the quality and economic results of iron and steel materials used in rural housing construction.

In recent years township enterprises have begun to develop a steel rolling industry, but the quality of its products is generally inferior and economic results are poor. The plan is to build new small rolling mills, coupled with a major effort to popularize them as much as possible.

5. The Popularization and Application of New Technology and Materials

More and more, biotechnology, microelectronics, and new materials are being put to use in an ever rising number of fields in the world over the last few years. Therefore, it is proposed that we select a number of new technologies which are advanced, require little capital, and pay off quickly, and use them to transform and equip small and medium-sized enterprises and township enterprises in order to upgrade their technical standard, improve their labor productivity and product quality, and increase their economic benefits.

Among major technologies to be developed are:

1) Biotechnology

(1) The production technology of new biological products, including microbiological polysaccharides, both edible and medicinal syrups, zymins, diagnostic reagents, Chinese caterpillar fungus, and nucleotide. The focus of development should be the production of fungi, production techniques, and special equipment.

(2) New biotechnology to transform the traditional fermentation industry, including the use of fixed fungi or fixed cells to make alcohol, beer, soy sauce, vinegar, and lactic acid, and the fermentation of white spirits. The focus is on the development of a fermentation reactor and its production technology.

(3) Embryo transfer technology, including embryo transfer and embryo separation in cows. The focus of development is to improve the success rate of embryo separation and the fertility rate of embryo transfer.

(4) The technology of the organized cultivation of plants, including the factory production of ginseng, bananas, cherries, and flowers. The focus of development is the fast breeding of cash crops and modern factory production of seedlings.

(5) The production technology of edible fungi, including technology for the artificial cultivation and factory production of mushrooms and tremella. Development should focus on the high-efficiency cultivation of the seeds of edible fungi, the development of new raw materials, and factory production technology.

2) Microelectronics

(1) Microcomputer applications in small and medium-sized enterprises and township enterprises. The computerization of the monitoring and process control of production information in small plants making cement, beer, leather goods, textiles, ceramics, and boilers for energy-efficient industries.

(2) Microcomputer applications in agriculture and enterprise management.

(3) The development of new technology with extensive applicability, far-reaching impact, and outstanding economic results, e.g., the use of radiation to keep foods fresh, and microwave treatment.

(4) The development of small commodities to enrich the lives of the people, making things convenient for them and adding an aesthetic touch to their existence, e.g., educational toys, tourist arts and crafts, and small articles of domestic use.

3) New materials

(1) The development of good-quality nonmetallic materials to replace steel and wood, e.g., polyvinyl chloride products, silicon carbon ceramics, and special engineering plastics.

(2) The development of other new materials, e.g., sesbania rubber, organic silicon, paint, binders, special rubber, and rare earths.

6. The Development of Parts and Components for Large Industries

There has now emerged throughout China a considerable number of specialized, small and medium-sized enterprises and township enterprises which revolve around the needs of large industries by supplying them with raw materials and semifinished products and by processing parts and components for them. The small enterprises also engage in multiple processing and comprehensive utilization, using the products or byproducts of large industries as raw materials. In the process, township enterprises have been able both to strengthen themselves and create a new set of favorable conditions for the development of their larger counterparts. By supplementing and stimulating each other, small enterprises have had a chance to grow and large enterprises

are invigorated. This mutually beneficial arrangement should become an important part of China's industrial structure. Since this covers an extensive area, it must be further studied and considered. It should also be considered a key aspect of the "Spark Plan" for which practical provisions should be made.

7. Comprehensive Regional Development

China's mountainous regions, which make up two-thirds of the nation's area, abound with resources and constitute an environmental defense for the plains. Because of historical reasons, there is at present a wide gap between their level of economic development and that in the plains; many mountainous areas are still impoverished. To put an end to their extreme backwardness is an urgent task for the Seventh Five-Year Plan. With an 18,000-kilometer coastline, China has vast stretches of beaches. Since the beaches have tremendous potential for economic diversification, they are particularly significant for small but densely-populated provinces and municipalities.

As far as the development of mountainous areas is concerned, the plan calls for the selection of 10 typical areas across the nation. Research and studies will be conducted to map out a development strategy and identify the key to economic vitalization. Within 3 to 5 years a model will be developed. To gain preliminary experience, experiments will be carried out at two of the areas to find the best blueprint for all-round development, using relatively stringent criteria. Then experiments will be launched in 10 typical impoverished counties to obtain experience in relying on science and technology to shake off poverty and achieve prosperity. In addition, about a dozen advanced pieces of technology will be selected, using resources unique to the mountainous areas. Turning to the development of beaches, eight typical beaches up and down the coast will be selected to be the sites for demonstration projects aimed at finding the best development plan and best technology through reviews and verifications. Development will focus on:

1) The comprehensive development strategy and the development of key resources in 12 mountainous areas: Changba, Taihang, Yanshan, Yimeng, Qinba, Wuling, Wuyi, Zhexi, Dabie, Luliang, Daba, and the mountains in the south (southern Hunan, northern Guangdong, and southern Jiangxi).

2) Classification of impoverished mountain counties and ways to lift them from poverty.

3) Infrastructural development in the mountains and research on the development of a model for all-round development.

4) Technology for developing edible fungi, mountain fruits, Chinese herbal medicine, precious animals and plants, and small tourist articles.

5) The comprehensive development of different types of beaches in such places as Hainan, Chaozhou and Shantou, the Minjiang estuary, Wanzhou, Yancheng, Caizhouwan, Cangzhou, and the Liaohe estuary.

6) The artificial compounding of feed for fish and shrimp. The artificial breeding of natural bait.

7) The breeding and processing of fish, shellfish, and algae. Seafood packaging technology.

8) High-yield prawn breeding technology.

8. Promoting the Establishment of Commodity Bases and the Development of a Commodity Economy

Resources must be allocated for the establishment of export commodity bases revolving around small enterprises. At the beginning, the bases must be set up in areas that have a solid infrastructure and considerable development potential and are well connected by transportation routes, e.g., along the coast from southern Jiangsu through Shanghai and Hangzhou to Ningbo, or in Fujian and Guangdong which have adopted special policies to open up to the outside world.

To relieve the shortages of nonstaple foodstuffs in large cities, there are plans to establish a number of vegetable, aquatic products, fruit, poultry and eggs, meat, and other nonstaple foodstuff bases during the Seventh Five-Year Plan. The tentative idea is to carry out two pilot projects, one in the north and one in the south. In the north, some areas in Hebei, Inner Mongolia, and Shanxi will be mobilized to concentrate on supplying Beijing and Tianjin with nonstaple foodstuffs. In the south, Jiangsu, Zhejiang, Anhui, and other places will do likewise for Shanghai and the Changjiang delta area. After reviewing the experience of these test sites, we will then gradually extend it to other places.

Because this issue is relatively complex since it involves other relevant regions and sectors, including production, transportation, storage, and marketing, it needs to be examined more closely in conjunction with other concerned parties.

9. The Development of Production Equipment

At present a conspicuous problem among small and medium-sized enterprises, particularly township enterprises, is backward technology and equipment, as demonstrated mainly by limited product variety and the many gaps in their product lines. Also, a majority of them still depend on manual operations, which are labor-intensive and low in productivity. Their product quality is inferior and processes backward. They fail to use resources comprehensively, produce poor economic results, and seriously pollute the environment. While some equipment has been imported from abroad recently, their operation is also ridden with problems. We must therefore use existing scientific and technical achievements in the nation and combine them with the absorption and assimilation of imported equipment to provide small and medium-sized enterprises and township enterprises with a number of complete sets of advanced equipment so that they can grow healthily on a new technical base and become more competitive.

In developing technology and equipment, we must not be solely concerned with whether or not it is on the cutting edge of technology, but should also consider whether it is applicable to our needs. We must develop technology that can be put together within a short period of time, pays off rapidly, and is worthy of popularization. It must also produce outstanding economic and social benefits. We must make full use of initiative at the local and central levels. Any project that can be handled by a province or municipality should be left to those jurisdictions. Projects which are technically more difficult and require inter-regional resources should be operated by the departments concerned. We must adhere to the principle of standardization and try to make coherent sets of equipment that are universally applicable. We must do our best to satisfy the demands of all quarters with as few complete sets of equipment as possible in order to facilitate mass production. Standards set by the state regarding food sanitation, work safety, and environmental protection must be strictly enforced. Development should focus on:

1) The industrialization and intensive production of poultry and aquatic products and processing equipment, including complete equipment for the industrial production, slaughtering, and processing of poultry and water fowl. Fresh water and salt water breeding and related processing equipment. Whole sets of machinery for feed processing.

2) The multiple processing and comprehensive utilization of agricultural products, focusing on complete sets of equipment for the processing of small oils and grains; the cultivation and processing of edible fungi; the processing of vegetables; cold storage, preservation, storage, and transportation; the factory cultivation of seedlings; and the processing of dried fruits.

3) Equipment for food and beverage processing. Development focus should be on small equipment for fruit processing, whole sets for small beer processing, processing equipment for the soybean family of products and small dairy products.

4) Building materials and machinery for rural housing construction. Development should focus on machinery to make wall materials using local resources, machinery to make tapestry bricks, simple construction machinery, and running water facilities in the rural areas.

5) The development of technology and equipment of a general or common nature, mainly packaging, drying, liquid transportation equipment as well as basic components and key common processes (e.g., heat treatment, anti-corrosion).

In addition, we should develop mining and processing machinery for small mines, equipment for the processing of special, native products, and equipment for the processing of light industrial and textile products.

10. Training Programs

In 1986, 200,000 people will be trained. The focus of the plan is to strengthen 51 training bases.

The primary purpose of the training programs is to provide training to the technical and managerial personnel of township enterprises who should be senior high school graduates or hold equivalent academic qualifications and be aged 35 or younger so that they can implement the "Spark Plan" and develop new industries and new technology. Less stringent educational requirements will be imposed as appropriate on trainees in regions inhabited by minority nationalities and economically underdeveloped areas. Through training, they will be equipped with one or two pieces of advanced technology applicable to their locality or with the basic knowledge indispensable to factory directors, managers, supply and marketing workers, or financial and accounting personnel. Training should emphasize the integration of theory and reality and take note of the different characteristics of different regions. It should make available whatever is needed.

To ensure the quality of training, training work should primarily be the responsibility of the state, provinces, municipalities, autonomous regions, and prefectural municipalities, with each jurisdiction looking after training at its own level. At the county level and below, science popularization programs will mostly be offered as part of the implementation of the "Spark Plan." At the national level, training will be a joint function between the State Science and Technology Commission, the Ministry of Agriculture, Animal Husbandry, and Fishery, and the Chinese Science Association. At the provincial level and the level of cities with province-level economic decisionmaking authority, training is a joint responsibility between the province, municipality and autonomous region. Resources permitting, prefectural municipalities should also do their best to offer training.

We must go out of our way to make full use of existing scientific and technical achievements in the country. Priority should be given to projects that will yield high economic benefits, can be completed in a short time, apply advanced and appropriate technology, and can earn foreign exchange or economize on foreign exchange. As for funding, the principle, "more from the locality, less from the state," must be strictly observed. In a joint effort to support technology development, the three parties--state, locality, and responsible unit--should adopt a "fund-matching" method of making investments. Most state funds will take the form of loans, with the ratio between grants and loans about 1:3. Upon the completion of a project, the unit concerned in principle is required to repay all the grants to the state, minus outlays on training. To stimulate technological progress and as an incentive to units that do well, however, the amount of repayment may be reduced depending on the performance of the project in question. According to statistics from 37 provinces, municipalities, autonomous regions, and cities with province-level economic decisionmaking authority, they had raised over 1 billion yuan on their own by early 1986.

The detailed organization and implementation of the "Spark Plan" is the responsibility of the various provinces, autonomous regions, municipalities directly administered by the central government, cities with province-level economic decisionmaking authority, and relevant agencies under the State Council. The principal functions of the State Science and Technology Commission are: research, planning, coordination, information exchange, work supervision, making sure policies and principles are enforced, and distributing government grants and loans. As far as technology development projects are concerned, the involvement of the commission is mainly limited to conducting interregional, interdepartmental projects that are technically difficult.

To ensure the standard and quality of technology and equipment development projects, we ask that all localities make it a point to invite the participation of scientific and technical personnel from research units under the various central ministries and commissions and the Chinese Academy of Sciences, from factories, and from institutions of higher education so that working together with unity of purpose, we can accomplish our mission. The "Spark Plan" opens up a brave new world for China's scientific and technical workers where they can give full play to their intelligence and expertise.

It is foreseeable that if we persevere with the "Spark Plan" on a long-term basis, spreading the sparks of modern science and technology among township enterprises and throughout the countryside, we are bound to gradually set off a fire of modernization, thus powerfully fueling rural economic reform, vitalizing the local economies, and opening up a path to local economic modernization that is in step with China's circumstances.

12581/6091
CSO: 4008/7

CHAPTER 6. DEVELOPMENT OF MOUNTAIN AREAS

[Text] In 1981, the State Scientific and Technological Commission set up a project for the comprehensive development of mountain areas with special emphasis on developing applied technologies and on exploring a development strategy for these areas. Within a short time, this project produced outstanding results. For example, the comprehensive development of the Taihang Mountains in Hebei Province began in 1981 and by 1982, provided with a total investment of 2 million yuan, increased net income by 33.6 million yuan. In 1983, another 3 million yuan were invested, while net income reached 50 million yuan, a fact which contributed much to high morale among the masses in the mountain area and strengthened their confidence in being able to escape poverty and attain prosperity. In August 1983, the State Scientific and Technological Commission convened the First All-China Symposium on Science and Technology for the Comprehensive Development of Mountain Areas in Shijiazhuang, Hebei Province. It reviewed experiences made in the Taihang and other mountain areas, formulated a tentative strategy for the development of mountain areas, and induced the whole country's science and technology sector to render service to the mountain areas. Up to the end of 1983, 27 provinces, autonomous regions, and directly administered municipalities had set up special projects for the scientific and technological development of mountain areas, devoting to these projects a work force of somewhat over 5,500 technical personnel. The ratio of invested technical progress to produced yield was on the average 1 to 10.3. In March 1985, the State Scientific and Technological Commission convened the Second All-China Symposium on Science and Technology for the Comprehensive Development of Mountain Areas in Nanning, Guangxi Province. It made further proposals for the reform of the science and technology system as applied to mountain areas, enhanced cooperative actions between local areas and central departments, promoted reform in the economic structure of mountain areas, and presented tentative ideas and proposals for the development of commodity economy in reliance on science and technology. At present, the development of mountain areas has become not only one of the key items of strategy of the commission, but also an undertaking that has the joint attention of all relevant departments of the central authorities as well as of local authorities; in many mountain areas rapid advances are now being made in economic development.

1. Significance and Urgency of Mountain Area Development

The term "mountain area," in a general sense, refers to hills and mountainous land as well as the valleys, basins, and bodies of water in them, and some high plateaus. China is a country with many mountains. Mountain areas cover about 6.49 million square kilometers, or two-thirds of China's entire area. There are 1,481 counties and cities mainly located in mountain areas, which is over 60 percent of the total number of counties and cities. The population of the mountain areas represents about 40 percent of China's total population.

Mountains contain important resources for the development of the national economy. Forests in China's mountains cover 1.6 billion mu of land, accounting for 90 percent of its total forest area. Timber reserves amount to over 8 billion cubic meters, accounting for 84 percent of that of the entire country. About 90 percent of the main economic forest trees, such as bamboo, tea-oil trees, tung trees, mulberry, tea, and fruit trees, grow in mountains, where many other valuable resources, such as medicinal herbs, edible mushrooms, and fur animals, are to be found.

Pastureland in mountains throughout the country cover over 3 billion mu, accounting for 60 to 70 percent of all pastureland. Of this total, about 1 billion mu are in the naturally grassy mountains and hills in the subtropical zone of the south, constituting a huge potential for the development of animal husbandry.

Today, cultivated mountain land accounts for about 44 percent of all cultivated land, but its average per unit area yield is low, and one should, therefore, consider withdrawing part of that land from cultivation and better use it for forestry or animal husbandry. Glaciers cover 57,300 square kilometers of mountain land. The annual meltwater runoff is about 49 billion cubic meters. The surface water resources of the mountain areas accounts for about 60 percent of those of the whole country, and the water resources in the high mountains and high plateaus reach 570 billion cubic meters and account for 76 percent of total water resources of the country's lakes. Of this quantity, freshwater reserves are over 110 billion cubic meters, accounting for more than half of the country's freshwater reserves. The country's resources of hydropower are about 680 million kilowatts, almost all concentrated in mountain areas.

Mineral resources of over 140 kinds ascertained in China are almost all in China's mountains, which, in addition, constitute an abundant resource for tourism.

Mountains serve as ecological protective screens for the plains. Protecting and improving the ecology of the mountain areas is not only an important task of reconstructing mountain areas, but has a bearing on the overall development of the national economy. Because much of China's mountain flora has suffered various degrees of destruction, erosion is an extremely serious problem, and frequent disasters are caused by mountain torrents, mud and rock flows, and landslides, all serious threats to communications and

production. In many regions desertification and increasing rocky soil has set in, silting of rivers and lakes is becoming more serious, hydrological conditions are deteriorating, and droughts and flooding occur with greater frequency.

Reversing all these developments will depend on the regulation and reconstruction of the mountainous territory.

Generally speaking, the mountain areas are economically very backward, and the people's living conditions are very poor. For more than 200 counties and for several tens of millions of people throughout China, it has not yet been possible to adequately solve the question of food and clothing. Most of these areas are the old revolutionary bases, areas predominantly inhabited by minorities, and border areas of our national defense. Achieving a complete change of conditions in the mountain areas is an arduous task, but also a glorious task that we are faced with. It is a pressing task that affects the overall situation of the entire nation.

2. Guiding Principle, Strategy, and Measures for Comprehensive Development of Mountain Areas

The fact that economic and cultural development of mountain areas lags behind that of the plains and of the coastal areas has historical reasons, as it is also a common phenomenon throughout the world. Eliminating this disparity cannot be achieved in a day. However, if full advantage is taken of the superior qualities found in mountain areas, it is indeed possible to change rapidly the overall conditions in these areas.

The superiority of mountain areas lies in their abundance of natural resources, while their inaccessibility is an obstacle to their development. As a result, many resources have potential, but no real economic advantage, because they cannot be converted to "use value" or "exchange value." In order to transform a potential resource into real advantage, it is necessary to adopt a correct policy and strategy, and take appropriate measures for comprehensive development and regulation.

Inaccessibility increases, of course, the pressure for self-sufficiency in mountain areas. In almost every respect, as to clothing, food, shelter, and transportation, the governing principle is: "a mountainman must depend fully on the hills for his living." Any backward natural economy will have a low potential to support its population, and resources within each sector of the mountain area are always limited. Particularly where people have nothing but simple and crude tools of production and use backward production technology, utilization of resources is very inefficient. To maintain a subsistence livelihood, it is necessary to be very wasteful with resources. With increases in the population, this extensive plundering of resources is bound to create excessive waste of several of the most used resources, which, in turn, will result in ecological deterioration. If allowed to continue, it will become a vicious circle of economic impoverishment and ecological deterioration. Should it not be possible to inspire enthusiasm among the people to "foster the mountains," to raise awareness among the people of the

need to exercise economy in consumption and to protect and replenish resources, the process of deterioration will accelerate, destruction will increase, and consequences will be very serious. The only thing to do, therefore, is to exert great efforts in developing communications, in developing commodity economy, enhance cultural as well as science and technology standards, increase productive forces, and at the same time control population increase. Only then will it be possible to truly achieve and maintain an ecological balance in the mountain areas, and attain a flourishing economy.

After liberation, China has done much to develop communications and other branches of the infrastructure in mountain areas, and reconstruction in these areas has indeed shown results. However, because for a long time attention was paid to cultivating only one kind of crop, development of diversified operations and of a commodity economy was neglected. Resources of mountain areas cannot rationally all be used up locally, but since imports of outside resources cannot be increased, there are limits to the capability of improving production conditions. There is the added circumstance that at one time emphasis was on "making grain the key link." Terraced fields were constructed on a large scale, and protection of forests was neglected, so that the flora of certain areas was ruined and erosion set in. Some areas lack grain, lack money, lack firewood, lack fertilizer, and some are actually at the end of their resources. The lesson these areas teach is grim indeed.

Protecting and improving forest ecology is an important measure in the development of the mountain area economy. Mountain areas must attach importance to growing forests and grass scientifically; this is beyond any doubt. However, if some propose to make "forestry the item of priority over everything else" in developing mountain areas, this is inappropriate. This formulation confuses ecological benefits and direct economic benefits of forests, and would easily lead to the unscientific conclusion of placing direct gains from forestry at the top of the entire production structure. Development of mountain areas must be an all-round arrangement, according to the correct policy of the Central Committee, which is to the effect that in agriculture, measures must be suited to local conditions, that operations must be diversified, that the production structure must be reformed, and that a commodity economy must be developed; only then will development be conducted in the correct way.

The State Scientific and Technological Commission reviewed the experiences in various localities and summed them up in the following three development strategies of present comprehensive development and management of mountain areas:

First, a strategy of quick success and immediate benefit, with consideration only for the immediate present and without regard for the future. This would mean in particular the indiscriminate land reclamation, random felling of trees, and reckless extraction of minerals, resulting in the depletion of resources and ecological imbalance. Very obviously, this strategy would be theoretically all wrong, and will hardly be supported or advocated by anyone. However, in actual fact, with a little carelessness and allowing things to

take their own course, allowing every village and hamlet to do its own thing, this would precisely be the state of things that would naturally result, and the danger of this happening would be very serious.

Another strategy would be to give attention to measures of regulation, to emphasize that we have to start with the improvement of the ecology. This, it is true, could solve the problem right at its roots, but it would require huge investments. Under the prevailing limitations to China's national strength, this scheme could be put into effect only in a section of the areas; it would be impossible to implement it over the entire area. As far as most of the impoverished mountain areas are concerned, if a way is not found as quickly as possible to first rescue them from their poverty, and if they cannot be assured of clothing and food, the masses will not have the strength to do anything to maintain and replenish the ecology.

A third would be a strategy that bases on the resources of the area in question. It would focus on the need to better the situation of the masses, would start with developments, begin with efforts to relieve poverty, and by means of developments would bring about overall regulation. The core of such a strategy would be reliance on the people of the mountain areas themselves, reliance on a correct policy, as well as on science and technology, to enhance the people's own capability to escape poverty and attain prosperity, while the state should support them within the limits of its power. A strategy of this kind will develop from little things to big things, will first effect small regulations, later large regulations, act according to available capabilities, and strive in a mutual interaction of development and regulation to attain the overall development of the mountain area economy.

In the last 5 years, many mountain areas have used the third strategy with excellent results. For some time to come, we should strongly advocate widest application of this method.

Although this strategy may be subject to adjustments in substance, according to different conditions in different localities, its application will be more or less uniform in the following measures:

(1) Starting with relief from poverty. Relying on, and selectively using applied technology, the resources of the area in question should be developed, as far as such resources are readily available, as far as there is a need for them in the market, as far as they can be easily put to use, and as long as such development does not harm the ecology. This should soon yield beneficial results for the peasants, increase their income, improve their livelihood, and have the effect of turning them from "have-nots" into "haves." They should then be guided to such medium and long-term projects as reconstitution of resources and regulation of the environment. Specific point of departure must be determined according to particular local conditions. The experience of most areas is in favor of starting with such items as dried and fresh fruit, raising smaller domestic animals, such as milk goats and rabbits, growing edible mushrooms and medical herbs, or to open up small mines.

(2) Further action to develop strong points and avoid weak ones. Adjusting the land use structure, appropriately considering withdrawing land from cultivation and making it available for forestry and raising livestock, integrating regulation of small drainage areas with expansion into diversified operations and development of resource buildup. At the same time, determining certain superior products of the locality in question that have good developmental prospects and setting up a coordinated production process in a continuous line of "trade-industry-agriculture" and of "planting-raising-processing," developing a processing industry, improving circulation channels, developing storage and transportation facilities, all actions which will ensure that the resources of the mountain areas will be utilized in every possible respect and at every stage. Acting in this way will contribute to a very large measure to the improvement of economic results.

(3) Expanding greatest efforts on improving such items of the infrastructure as transportation, water supply, and communications; improving residential areas, establishing industrial districts and commercial markets, so as to continuously improve the level of production, the standard of living, and the quality of the environment.

Whenever actual conditions at a certain place are well integrated, and appropriate methods and steps are taken, comprehensive development of mountain areas and their reconstitution can indeed attain outstanding results. For instance, some mountain areas in Miyun County of Beijing Municipality suffer from a serious shortage of water and from a lack of the basic means of livelihood. For a time, it was impossible to improve the local situation, so they adopted the method of moving down from the mountains and setting up industrial districts. Because of serious ecological damage inflicted on certain districts of the loess plateau, the state granted financial aid to restore its flora. In certain mountain areas of the south, a start was made by developing roads, which was yet another method. In sum, taking action according to the particular conditions of the locality in question and taking measures that match the reality of the situation, can produce very good results.

3. Experiences of Hebei Province in Developing the Taihang Mountains

(1) After liberation, many roads, reservoirs, and terraced fields were built in the Taihang Mountains, but conditions of livelihood there are still very poor. Up to 1980, the average annual income of one-third of all commune and production brigade members was only 50 yuan. Beginning in 1981, arrangements were made to have Hebei Agricultural University work out a development strategy for the Taihang Mountains. They recognized that having Taihang "take grain as the key link," and cut down evergreen forests, i.e., give up the two advantages of growing fruit trees and raising livestock, landed the peasants in the predicament of having neither money nor grain nor firewood, and that it had been indeed the wrong way to go. Poverty aggravated calamity, and calamity, in turn, aggravated poverty, creating a vicious circle. Now, as we want to reverse the situation, we have to utilize strong points and avoid weak spots; the starting point must be utilization of available resources. If only funds were available, investments could be increased,

and grain and firewood problems could easily be solved. What is there on which to base development of mountain areas? We must rely on state policy: now, having instituted the production responsibility system, the gate to prosperity has opened widely. Sole reliance on state investments is obviously not realistic. It is, therefore, most important to have science and technology introduced into the mountain areas, and to rely on science and technology to bring relief from poverty and lead to prosperity. All experiences of the Hebei Agricultural University experimental station make it clear that if there is scientific guidance, the peasants will indeed be able to turn available resources into wealth. To achieve relief from poverty, the peasants must show desire and capability for ecological reconstruction. During the first phase, when determining projects for the relief from poverty, one must not aim too high, but rather advance steadily step by step. This means one must not fear starting too low, but everyone must be enabled to exert all his or her energy, and one must, furthermore, accelerate the turnover of all available limited financial and material strength. It will then snowball: the scope of development of the mountain area economy will then be able to grow larger and larger from its small beginnings. The State Scientific and Technological Commission has affirmed this experience, and in 1981 set up development of the Taihang mountain area as a special topic of research. The contribution made by the practical experiences of developing the Taihang Mountains are: First, that it determined a correct strategy for the development of mountain areas, and that, furthermore, it explored and evolved a set of new methods, namely by having strategic ideology rule all experimental development projects, and at the same time utilize large-scale regional experiments closely linked with production, to verify strategy and other systematic research methods.

(2) Breakthroughs in Many Sectors, Rapid Dissemination of Results, Doing Great Things With Little Money

Professors and students from various departments of Hebei Agricultural University went into various counties deep in the Taihang Mountains, and, together with the many local cadres, studied and selected "breakthrough points" for ways to prosperity out of poverty. They sought out development targets and appropriate technological methods that required little investment, had a reliable market, and could easily yield good results. Some that showed great results and could widely be used were raising rabbits on leaves of locust trees and increased production of dried and fresh fruit. To change the past method of spending money on prototypes, which is a method the peasants cannot afford to learn, they determined to gear methods to the needs of the peasants and firmly refused to follow a policy of "each cooking on his own little stove" in operating experimental stations. Each experimental station must use experiences worked out in its selected area to promote work in the entire area, must be responsible to provide models, provide advanced "materialized technologies" for raising rabbits and manufacturing pesticides, must be able to accomplish the tasks of training, giving consultations, and guidance over the entire area. Moreover, in the deployment of experimental stations, they applied a multilevel type of deployment: the professors of the agricultural university led the group of county and village technical staff at the experimental station, the technical staff returned to their

posts and helped science and technology households, the science and technology households helped the general households. In this way, one experimental station promoted progress over a wide area. As to the expenses of providing "materialized technology" and operating experimental stations, this was also changed from the old method of having the state assume all responsibility to the new methods of "sharing expenses among several households" and "financial aid with due compensation." For instance, a peasant will borrow one pair of rabbits and return one or two pairs in the fall. In this way, the state investment is like a spark that ignites an explosion, strong enough to light up the entire prairie, all this to accelerate turning poverty into prosperity in the Taihang Mountains.

(3) Setting Up Processing Industries, Organizing Technological as Well as Supply and Marketing Services, Turning Resource Affluence Into Market Affluence, Increasing Value

After achieving breakthroughs with applied technology, the provincial party committee directed main efforts toward development of processing industries, which would increase product value several times over. However, if problems in the means of circulation and in the quality of the products are not effectively solved, products will still not be able to gain a market. Key attention was, therefore, directed to the development of new varieties, new products, and on improving quality. At the same time, the former administrative-type promotional organization was transformed into a business-type entity integrating processing, supply and marketing with technological servicing, which, on the one hand, helps the peasants sell their products and, on the other hand, provides modern means of production and technical services. This form of organization promotes an integration of institutions of higher learning with village economy and opens up a new phase in the development of the Taihang Mountains. Fuping County imported 12 items of technology from Tianjin, Baoding, and other places for the processing of preserved fruit, fruit wines, and furs, also built 37 fruit product processing plants, which process almost 4 million jin of various products, of which 3.8 million jin are Chinese date products, having a gross value of 5.85 million yuan and yielding over 3 million yuan in net profits.

(4) A Fight Waged Jointly by All Sectors Under the Unified Leadership of the Provincial Government

Development of the Taihang Mountains was launched right from the start under the leadership of the Hebei Provincial Government and supported by all sectors. The province established a Taihang Mountains development center with a board of directors, to which leading officials of the relevant departments and bureaus were appointed as members. With a common goal before them, a coordinated fight was waged with the combined resources of all quarters. The provincial transportation department has allocated over 20 million yuan in the last 3 years to repair and build over 1,200 km of mountain roads. Other departments and bureaus, such as water conservancy, agriculture, forestry, commerce, supply and marketing, trade, civil affairs, education, etc., also closely cooperated and did much work.

12581/6091
CSO: 4008/7

PART IV. COMMERCIALIZATION OF TECHNOLOGICAL ACHIEVEMENTS

CHAPTER 1. DEVELOPMENT OF TECHNOLOGY MARKETS

[Text] In March 1985, the "CPC Central Committee Resolution on the Reform of the Science and Technology System" pointed to the "promotion of commercialization of technological achievements and opening up of technology markets, in order to adapt to the development of a socialist commodity economy." Following the reform of China's S&T system, technology markets are being set up in China, to form an important component of the unified socialist commodity market, to link S&T with economic construction, and to form a bridge that will allow scientific and technological achievements to enter material production.

The term "technology market" refers in essence to the sum total of exchanges of knowledge as commodities.

Formation of technology markets is an objective demand by China's progressive socialist commodity production. It is the inevitable product of S&T socialization, and is bound to be strongly felt as a vital force in China's socialist modernization.

1. Course of Development of China's Technology Markets

(1) Course of Development of China's Technology Markets

China's technology market developed principally in three stages:

First stage: Stage of germination of technology markets. At the 1978 All-China Science Congress, Comrade Deng Xiaoping profoundly presented the Marxist standpoint that S&T are productive forces, that modernization of S&T is key to accomplishment of the four modernizations, and that it is an ideological and theoretical foundation for commercialization of technological achievements and the opening up of a technological market. This is how trade in technologies, i.e., trade in scientific and technological achievements, emerged and how the technology market in China came into being. A characteristic of technology market activities in those days was that scientific research units and production units voluntarily joined in accomplishing certain tasks they were faced with. Research units began to transfer scientific and technological results to production units, to provide consulting services and to assist enterprises in solving technical difficulties in production, and received remuneration.

Second stage: Stage of initial formation of technology markets. At the 1982 All-China S&T Reward Meeting, Comrade Zhao Ziyang, representing the CPC Central Committee and the State Council, pointed out the strategic principle: "Economic construction must rely on S&T, and S&T must be geared to the needs of economic construction." Acting on this principle stimulated the development of China's S&T in coordination with economic and social affairs, and, furthermore, accelerated the formation of China's technology markets. Technology market activities began to enter a stage of well-organized and well-guided progress. As to operational patterns, a diversity of forms and channels emerged, and the scope and range continuously expanded: this is the way the technology market started.

Third stage: Stage of development of technology markets. The State Council's "Provisional Regulations on the Transfer of Technologies" of January 1985, as well as the "CPC Central Committee Resolution on the Reform of the S&T System" of March 1985, pointed out: "Technology markets are an important part of China's socialist commodity market." The status and role of technology markets in China were thereby fully affirmed. Important breakthroughs were made in principles regarding the commercialization of technological achievements, and China's technology markets rapidly developed in conformity with the trend of the general reform.

(2) Primary Functions of China's Technology Markets

1) Technology markets are free from restrictions by central and local authorities, break down departmental separations as well as separations between city and countryside, allow rapid dissemination of technological achievements, and open up channels for the circulation of intellectual commodities.

2) Technology markets promote integration of scientific research with production, help gear scientific and technological work to the needs of society and the economy, and change work styles of scientific research units which formerly had been only interested in achievements and unconcerned about their practical application.

3) Emergence of technology markets facilitated the reform of the system of state allocations of funds and will help research units gradually attain economic self-sufficiency. According to statistics for 1985 alone, China's scientific research organs had an income of 470 million yuan from technology transfer in the civilian sector.

4) Technology markets promote scientific and technological transfers. They constitute a technological back-up for enterprises and support their production. Many Chinese enterprises work with obsolete equipment and backward techniques. More and more, medium and small enterprises as well as rural enterprises especially need new technologies and research achievements, which were unobtainable for them in the past, but which the technology market now enables them to buy to satisfy their needs, even by public tender, for certain items. Production-related technological problems are thus solved.

5) Technology markets promote circulation of intelligence and talented personnel. Certain knowledgeable persons of true talent and learning will now find ample scope for their abilities in service of the four modernizations. S&T personnel are the ones who pave the way for new productive forces. With technology markets, technological achievements developed by the many scientific and technological personnel are streaming into actual production. At the same time, the transfer of achievements promotes mobility for larger numbers of qualified personnel and dissemination of much knowledge, thereby stimulating the enthusiasm of those engaged in scientific and technological work.

(3) Characteristics of China's Technology Market Development

1) Field and Range of Technology Trade Continuously Expand

The state's adoption of the principle and policy of "opening up to the outside world, invigorating the economy, supporting and guiding" promoted the active development of the technology market. Trade in technologies has spread to all corners of the country. National or regional technology development organizations emerge constantly. Cooperative mass organizations, such as the nationwide cooperative network for the development and interchange of technologies and talented personnel, regional cooperative networks in northeast, northwest, south central, and north China brought about the development of technology markets all over the country. National or regional trade fairs are being held continuously and technology trade is thriving nationwide on an unprecedented scale. According to incomplete statistics, various localities throughout the country held 18 fairs within 6 months from the publication of the "CPC Central Committee's Resolution on the Reform of the S&T System." At these fairs, over 30,000 items were the subject of trade talks which led to transactions worth 9.6 billion yuan.

The impact of technology markets are felt far beyond the S&T sector, as they attract attention throughout the entire society. Technology trade is gradually expanding from industrial projects to many other fields, such as agriculture, medicine, and capital construction. The trade is conducted not only by scientific research units and institutions of higher learning, but also by units of the defense industry, and of industrial and mining enterprises, hospitals, designing units, and others. Economic, banking, finance, and labor service units which have close links with S&T, begin to get involved in the technology market. Some of them opened up new fields of consumption to be supplied by technology markets, while others, in close relation with such markets, organized new technology/finance markets and technology/means of production markets. The technology market has come up with many new looks. At the first nationwide technology fair, provincial and prefectural banks from Hunan, Hebei, Hubei, Fujian, Jilin, Shaanxi, and Shanxi brought along funds in the millions and tens of millions to support the transactions of their provinces, demonstrating a new integration of financial markets with technology markets.

2) More Organs, Organizations Engage in Technological Commodities Trade

The state's advocacy of a policy of uplifting the people, the collectives, and individuals together, and the multilevel, multichannel development of technology markets, resulted in the emergence of many intermediary organs of all kinds in the technology trade. There are now over 1,100 technology exchange centers of prefectural and municipal level throughout the country, and over 3,000 technology service and consulting organs. Every trade and profession has established its own technology trading organ. In many regions, the technology service organs form networks, reaching beyond their own terrain, and mutual competition has already begun to emerge. These intermediary organs are active intermediaries between scientific research units and production units, thus assisting in the development of technology markets.

3) Constantly Expanding Range of Technology Trade

The items of technological commodities traded in technology markets are constantly increasing, growing from a few to a large array of items, from single to multi-operational items, from the paid transfer of scientific and technological achievements, technical services, and technical consultations, to contracting for technological projects, investing in technical advances as shares, and participating in joint ventures and technical training.

(1) Plan items of the state and local governments begin to appear in the technology market. Many plan items, such as capital constructions, renovations, and execution of key projects of provinces, counties, and prefectures make use of the technology market in large numbers. Public bidding, comparison of goods offered by various suppliers, and selection of the best technology, precede the effective execution of the projects in questions.

(2) The many contracts for comprehensive engineering projects have changed the way transactions formerly used to be limited to one single item of technology. At that time, those working on one particular technique did nothing else, and those working on one particular piece of equipment did nothing else, so that it happened that different pieces of equipment would not fit together. According to the new method, therefore, contracts are for complete sets of equipment for the comprehensive processes of scientific research, designing, manufacture, and construction.

(3) Technologies are introduced by public bidding in domestic technology markets. For items that formerly would have been imported, people now turn to domestic technology markets, invite tenders, and tap domestic technological potential.

(4) Technological commodities useful for medium and small enterprises, as well as for village and township enterprises, are constantly increasing. Many research units, institutions of higher learning, and large industrial and mining enterprises now specially turn out technologies which are rather unimpressive, but suitable for medium and small enterprises, as well as for village and township enterprises, a welcome trend. Several technological

commodities of the light industry, highly relevant to raising the standard of living, improving economic results, developing production, and opening sources of income, also technologies of the food, construction materials, and petrochemical industries have become items in great demand in the technology market.

4) Greater Flexibility of Forms in Technology Trading

The following are roughly the forms employed in technology trading:

(1) Permanent technology markets. No time limits are set for these markets; constant trade is conducted in technological commodities. This system enables prompt negotiations and transactions between sellers and buyers. Tianjin, Beijing, Wuhan, and Shijiazhuang have set up permanent technology markets of this kind and achieved very good results.

(2) Mobile technology markets. These markets have a fixed place of business, and employ a great variety of flexible forms to introduce suitable technological achievements to village and township enterprises and factories, providing door-to-door service, which is highly appreciated by buyers.

(3) Science and technology achievements fairs. These fairs are held at certain places and at certain times. They present in concentrated form and at one place scientific and technological achievements of research institutes, institutions of higher learning, and of defense industry units, and show other advanced technologies, enabling direct personal contacts between these units and production units, in a close integration of S&T with production. At the first All-China Technological Achievements Fair, held from 15 May to 7 June 1985, 29 provinces and municipalities and 78 trade delegations from 49 relevant departments and commissions participated, a total of over 3,000 units. More than 20,000 achievements were shown at the fair, which was attended by over 300,000 staff members. During the 25 days of the fair, 4,180 formal contracts were signed, worth a total of 2.1 billion yuan.

(4) Technologies as share investments, organizing composite scientific research-production entities. This form of technology trading by forming a composite body can, on the one hand, mitigate and solve the problem of the buyer's shortage of funds and still provide the enterprise with a steady and reliable technology, and, on the other hand, provide the scientific research unit with a steady source of money, while both sides will jointly bear risks and share benefits. According to incomplete statistics, there are now more than 10,000 composite organizations of these scientific research-production entities in China.

2. Unresolved Problems in the Development of China's Technology Market

The following are presently major problems found in the operation of the technology market:

(1) Lack of accurate knowledge about the development of technology markets; a trend to emphasize form and neglect substantial results. Some localities

and sectors have set up many intermediary organizations, but have failed to take resolute measures; their technology trade remains dull and indifferent. Some units one-sidedly pursue profits. Some units and individuals will want to transfer technologies that are immature and unreliable, and some even go so far as to commit outright fraud by peddling false technologies.

(2) Administrative work cannot catch up with the needs of technology market development. In some places, technology trade is not yet on a rational track. There is no unified organization to examine and approve new technology trade organs. Various sectors set up their own systems and cause new disruptions in vertical and horizontal relationships.

(3) Some policies and provisions are not sufficiently clear and specific, leaving gaps as to the range of technological commodities, the conclusion of technology contracts, and the taxation of technology trade, so that there are no rules to go by. Other conditions, although covered by provisions, are administered by many different offices whose interpretations differ, which creates difficulties in understanding and application in different localities.

(4) Insufficient zeal for purchase of technological commodities. The reasons for this problem are, first, enterprises lack sufficient funds, and there is a lack of an appropriately encouraging policy and appropriate measures in the financial sector. Second, there are no evaluation norms for technological progress in factories and enterprises, and some plant directors, after the system of office tenure for determinate periods was introduced, will not attach too much importance to long-range technological development.

A healthy development of the technology market requires solution of the following problems:

First, we must enhance knowledge, rectify guiding ideology and strengthen education in the socialist ethics of technology trade. Through propaganda, all our numerous cadres and the masses must be made to clearly realize that the technology market has been established as an important policy decision that is part of the reform of China's S&T system. It is a measure which forcefully implements the strategic policy of "economic construction must rely on S&T, and S&T must be geared to the needs of economic construction." Propaganda must also increase the sense of urgency and a consciousness to rely on technology in the development of commodity production, as it must also raise zeal to initiate technology trade.

The guiding ideology for the operation of technology markets in China is that the "CPC Central Committee Resolution on the Reform of the S&T System" must be implemented, that the principles of "opening up, invigorating, supporting, and guiding" must be upheld, that technology trade must be initiated through a variety of channels, at many levels, and in many forms, and that technology markets must fully exercise their role as bridge and link for the most rapid transformation of scientific and technological achievements into productive forces.

In all technology trade activities, the ideology must be one of service to the people and of efforts toward greater contributions to socialist modernization, of educating all parties in technology trade to acquire a correct attitude in all transactions, to consciously observe the state's decrees, rules and regulations, as well as state policy, to respect science, and to reflect, realistically and truthfully, the conditions, as well as the extent and circumstances of use, of technologies offered for transfer.

In the current rectification of unhealthy tendencies, we must draw seven distinctions according to state policy, to protect the legitimate rights and interests of scientific and technological personnel:

(1) We must draw a distinction between promotions, rewards, floating salaries and wages, which scientific research units, engaging in experimental reform, are entitled to enjoy according to relevant documents of the State Council, on the one hand, and abruptly raising persons to cadre positions, unduly issuing bonuses, and indiscriminately increasing salaries and wages, on the other hand.

(2) We must draw a distinction between rewarding S&T personnel who have made contributions, and large rewards to S&T personnel who have made major contributions, on the one hand, and the arbitrary payment of rewards under various pretexts, on the other hand.

(3) We must draw a distinction between S&T personnel receiving reasonable remuneration for appropriate work on concurrent posts and for sparetime intellectual work, on the premise of their completing work at their principal posts and not encroaching on technological or economic rights and interests of their principal units, on the one hand, and such personnel neglecting work at their principal posts, while seeking private gain elsewhere, on the other hand.

(4) We must draw a distinction between S&T personnel, who, with prior consent of their units, join enterprises or go to the countryside to engage in technological development or to contract for technological projects, either remaining employees without pay at their old place or accepting employment at the new place, on the one hand, and staff leaving without fulfilling proper formalities, merely seeking personal gain, on the other hand.

(5) We must draw a distinction between having enterprises in remote border areas or villages, or medium and small enterprises, publicly advertising for S&T personnel, offering favorable terms, and doing so in places of large concentration of such staff or where such staff are not fully utilized, on the one hand, and the use of unfair methods to undermine the operational bases of others and drawing S&T off into irrational directions, on the other hand.

(6) We must draw a distinction between S&T units and personnel opening technology markets and engaging in technology trade in a variety of forms, on the one hand, and party and government organs or their cadres misusing the powers of their offices for personal gain while engaging in commerce and operating enterprises, on the other hand.

(7) We must draw a distinction between research units and S&T personnel starting technology development companies and through transfers of technologies, and launching technology consulting services against rational remuneration, on the one hand, and those who buy and sell for purposes of speculation and profiteering to garner huge profits under the false facade of technological development, technological transfers, and technological consulting services, on the other hand.

Second, we must strengthen science and technology legislation and promote in-depth development of technology markets.

For the accurate handling of mutual relations between producers of technological commodities, between receivers of technological commodities, and between buyers and sellers, as well as between the state, the collectives and the individuals, technological legislation should formulate norms governing the relationship between rights and obligations from technology contracts, so that this trade may be protected by law, and that an enlightened and rational order be established in the technology market, ensuring smooth transfers of technological commodities.

State policy is the foundation of legislation. In order to have S&T legislation start out from the purpose of supporting the development of technology markets, as well as to take account of and protect the legitimate rights of sellers, buyers, and intermediaries in this trade, it is necessary, as a matter of policy, to solve the following problems in a gradual process of improvements:

(1) Enterprises which are prospects for technology transfers should be encouraged in every possible way to buy technological commodities. Their zeal for the use of technological achievements should be raised, and they should be assisted economically, enabling them to purchase technological commodities. As to ways of dealing with expenditure for the purchase of technological commodities, enterprises may enter such expenditure as business expenses, and may enter additional profits accruing from use of new technology as before-tax expenditures, to be spread over several periods as production costs. It should also be possible to open special S&T credits, stipulating differing rates of interest and repayment terms, according to the particular conditions in question, in order to increase purchasing power. Another way would be to have the state, collectives, and individuals jointly raise the necessary funds by investing in projects as shareholders. The state's S&T funds and renovation funds should also be primarily invested in technological items that are advanced in nature and promise good economic results.

(2) Any party transferring technology must be encouraged to satisfy as far as possible all technical and economic demands of the user, so that the technological commodity suits the needs of economic construction. Scientific research units and any other party transferring a technology must be encouraged to gear such action to the needs of economic construction; they must at all times be familiar with the actual needs of production, know exactly the capability of the enterprise to use the technological commodity, and must be

offering a technical achievement that is marketable and economically effective. Technological achievements that prove to be of great economic benefit in production should be awarded prizes. Scientific research projects that are risky and will require longer periods of time to work out should be supported with necessary funds, thus strengthening the logistic support for S&T units that produce technological commodities.

(3) With respect to prices, taxation, and distribution, the legitimate rights and interests of buyers, sellers, and intermediaries must be protected. The state should not restrict prices for technology transfers, but allow prices to be negotiated by the parties concerned. All income from technology transfers should be tax-free. Sales of new products should enjoy favorable tax rates within a certain period of time. The party transferring a technology should be allowed to withdraw a certain proportion of the net income from the technology transaction, to be used as reward money for the person or personnel directly responsible for the development of the technology in question, and this amount should not be included in the total amount of the reward fund. Intermediaries should be allowed to withdraw a certain amount as middleman's fee. Protection of the legitimate rights and interests of buyers, sellers, and intermediaries should stimulate their enthusiasm and promote the development of the technology market.

3. Perfecting the Organizational System, Instituting Effective Administration

(1) Establishment of a special organization for the overall coordination of technology market affairs. The state having already set up a guidance team for the nationwide coordination of technology markets, all localities should set up corresponding organizations, headed by the science commissions and participated in by departments in charge of economics, finance, taxation, banking, industry and commerce, judicial affairs, education, and statistics. They should determine technology market policies, draw up technology market rules and regulations, work out solutions for problems in technology market operations, coordinate relations between all parties, and exercise macro-guidance. This organization could be charged with verification and administrative control of contracts of the locality concerned, with the examination and approval of technology trading organizations, and with relevant statistical and planning work, so that this organization in administrative charge of technology markets will truly fulfill its duties and responsibilities, and avoid confusion in the administrative control of technology markets.

(2) Strengthen verification, notarization, and administrative work concerning technology contracts. To ensure smooth technology trade operations, we advocate technology contracts, concluded between the parties concerned, verified or notarized by a relevant office. In the case of major transactions, the two parties should also be urged to arrange, after verification of the technology, for separate technical and economic demonstration.

(3) Intensified examination, approval, and readjustment of organizations trading in technologies. Norms for examination, approval, readjustment, and admission of organizations trading in technologies shall be rationally

determined and strictly applied, according to the substance of their work, the orientation of their services, the composition of their personnel, their business capacity, as well as with regard to funds available for their operations, their place of business, etc. Companies that do not conform in all respects, or do not observe the relevant decrees and provisions, must be firmly banned.

(4) Training of qualified persons for technology trade operations, raising the quality standards in technology trade operations. At the same time that we arrange for personnel currently engaged in technology trade operations to continuously upgrade their specialized technical knowledge, they must be made to study economic theory and law, and made proficient in the methods and rules of economic accounting and economic analysis. They must be able to continuously improve themselves professionally in such fields as S&T, economics, and law, to gain competence for technological checking and verifications, so as to guarantee that the technology market will be operated with high efficiency, high results, and in good order. S&T personnel who work in the administrative organization controlling the technology market and others who are engaged in technological commodity trade should be remunerated, and their posts designated, according to relevant provisions. We should treat them without discrimination on an equal footing with S&T personnel engaged in research and development. Those who contribute outstanding achievements should be given rewards.

4. Development Strategy for Technology Markets

(1) Objective of Development

Main purpose of China's well-organized and well-planned opening of technological markets is to open up all possible channels between scientific research and production, to create technological interchanges and a trading system of nationwide scope in a crisscross pattern extending in all directions, and to strive to turn all scientific and technological achievements as much as possible into productive forces.

1) Main goals of the technology market are: First, the dissemination and application of presently available S&T achievements; second, the technological transformation of traditional industries; third, the development of new technologies and industries, with the intention of creating, through interchanges and trading activities in the technology market, a powerful impulse for technological progress and economic results of large magnitude.

2) As regards trading organizations, the development goal is to rectify, adjust, consolidate, and perfect those trading organizations that are presently operating, have them develop at a steady and continuous pace with assurance of quality and quantity, and have them gradually form one entity for trade in technological commodities. The trading organization should obtain remuneration for bringing about technological transactions and for ensuring the smooth conversion of S&T items to productive forces, thus enabling them to gradually attain economic self-sufficiency within a few years.

3) As to the technology market system, the goal is to uphold the principle of centralized guidance, unified administration, numerous traders, and rational competition. We should depend on key cities, and achieve effectively administered and greatly invigorated technology markets by gradually building up an administrative system that integrates all vertical and horizontal relations, internal and external factors, and that possess a strong attractive and radiative quality.

4) As to beneficial results from the operation of the technological market, the goal is to bring about, through technology trading of all kinds, yearly increases in the volume of transactions and in social results, a gradual increase in the factors conducive to scientific and technological progress, and to have the technology market exercise a role of growing importance in China's economic construction.

(2) Direction of Development

1) China's technology market was developed from nothing and rose from low rank to high rank. We should achieve a state where the scientific achievements of scientific research units can be promptly introduced into the market, where enterprises can at any time buy whatever technologies they need, where technological projects may at any time publicly invite tenders, and where technological interchanges and trade can be conducted through a continuously flowing stream of information. This demands that the technology market promptly disseminate information and operate an effective news network to suit the needs of the developing technology market.

2) Change of the technology market from a seller's to a buyer's market. Following the reform of the S&T system and the development of commercialization of technological achievements, all scientific research units gear their efforts increasingly to the needs of economic construction, and the technology market will be changing from a seller's to a buyer's market. The demand from production units for scientific and technological achievements is continuously growing and continuously coming up with new themes from production practices. This will induce the scientific research sector to aim at conducting research of problems from production, to act with definite objectives in view, and to enhance the applicability of technological commodities.

3) The technology market will change from a completely free, unplanned market to a market integrating semiplanned and free market components.

4) The technology market will change from handling low quality to high quality commodities. Technological commodities now being traded in the technology market are, from a quality point of view, mostly of low quality. Most buyers are medium and small enterprises or village and township enterprises. To satisfy the urgent need of large and medium-sized enterprises to advance through reliance on technology, the technology market must increasingly add sophisticated or high-quality technological commodities. The technology market will therefore change and handle not only common items, but also medium and high quality technological commodities.

5) Change from a purely domestic market to one that handles domestic as well as foreign items. Following the development of the domestic market, certain advanced Chinese technologies will be introduced into the international market. From April 1985 to October 1986, the State S&T Commission arranged the first technology exports to be exhibits at the British technology exhibition. They took along 29 technologies, and as a result of the exhibition, 18 letters of intent, 1 agreement, and 2 contracts were signed. This test case opened up a new channel for certain Chinese advanced technologies to enter the international market, and to be exported and earn foreign exchange. The test case is beneficial for the future exchange of advanced technologies with foreign countries, for the qualitative improvement of technologies and for greater economic results.

9808/6091
CSO: 4008/7

CHAPTER 2. TRANSFER OF TECHNOLOGY FROM THE MILITARY TO THE CIVILIAN SECTOR

[Text] China's great progress in national defense S&T, during the 30-odd years since the founding of the PRC, has had an immense effect on the consolidation of national defense, on scientific and technological progress and on economic prosperity. Especially detonation of an atomic bomb and successful launching of a guided missile and a man-made satellite in the 1960's indicated that China's defense industry and S&T had entered a new phase. The development of defense S&T, in turn, promoted developments in China in a series of basic sciences, such as mathematics, physics, mechanics, electronics, optics, chemistry, and acoustics, and in the many new technologies, such as computers, microelectronics, new materials, biology, automatic controls, space navigation, atomic power, remote sensing, and communications. Thus, an industrial system of defense S&T has been built up that covers fairly completely the whole spectrum of the field, and is of a very high standard and broad range. China has thereby become one of the few countries in the world that can rely on its own strength to supply its armed forces with all the weapons and equipment they need. Since the Third Plenum of the 11th CPC Central Committee, there has been a change in the strategic policy governing the development of the defense industry, namely from a purely military to a combined military-civilian system, from an industry that mainly serves national defense to one that serves both, national defense as well as the national economy. This change will play a conspicuous role in accelerating China's economic development and its defense buildup.

In the course of developing and manufacturing sophisticated as well as ordinary weaponry, defense S&T has mastered an extensive series of new technologies, some applied for the first time in China and some actually at, or almost up to, international standards. Spreading their use widely throughout all areas of the national economy can result in considerable economic results. There are, for instance: atomic energy technology, isotope and irradiation technology, remote detection and sensing technology, automatic control technology, electronics technology, laser and infrared technology, precision processing industry, as well as all kinds of analytic and testing technologies and special techniques. The defense industry possesses a considerable number of advanced items of equipment and a scientific and technological work force of high technical proficiency, capable of tackling problems with great energy. They have the capability of contracting for every type of large engineering project, of providing a wide range of technological services, and of developing new technologies and products, either singly or in cooperation with other relevant parties.

In recent years, the various departments of the defense industry have conscientiously implemented the Central Committee's policy of "integrating military and civilian uses." While ensuring completion of all weaponry and military equipment research and production tasks, and continuing to develop production of civilian items, they began to actively transfer defense industry technologies to civilian use, bringing the superiority of the defense industry to bear in their service to the national economy, and thus ushering in a new phase in the integration of military and civilian uses of their technologies. According to incomplete statistics covering 15 provinces and municipalities throughout the country, the defense industry, in 1984, signed more than 6,800 contracts with civilian manufacturing units for the transfer of all kinds of technologies. This number of contracts is 16 times that of the preceding year, and involves transactions worth 430 million yuan. Since 1985, transfers of military technologies to civilian use accelerated further. According to statistics on the transactions at the "First All-China Fair for the Transfer of Military Technology to Civilian Use" and the "First All-China Technology Achievements Fair," the defense industry signed almost 10,000 technology contracts, agreements, and letters of intent of all kinds with civilian manufacturing units, contracts worth more than 700 million yuan. In August, at the "All-China Symposium of First and Third Line Regions on Cooperation," military and civilian units again signed 314 contracts, agreements, and letters of intent, worth 350 million yuan. Many of these items were placing defense industry technologies at the disposal of economic construction through a variety of forms of economic and technological cooperation. According to preliminary statistics, almost 10,000 items of defense industry technologies are being transferred to civilian use, with transactions amounting to around 1 billion yuan. Through just a few short years of efforts, defense industry technologies have begun to play a positive role in many areas of the national economy and achieved important results, as mainly manifested in the following:

1. Transfer of military technologies to civilian units stimulated progress in civilian technologies and raised overall beneficial results. For instance, introducing the use of heat exchangers for heat ducts, as used in satellite temperature control technology, to the metallurgy and textile industry saved large amounts of energy. Use of this technology in the development of heat duct heat exchangers at the steel-smelting furnaces of the Anshan Steel Works not only raised the utilization ratio of furnaces, but saved 700,000 yuan per year in fuel costs at each furnace, a saving which is over 3 times the cost of the heat exchangers. The Ministry of Nuclear Industry adapted extraction techniques in uranium smelting to the smelting of tungsten and achieved outstanding results. They cooperated with Tianjin in employing pulse sieve plate columns for the extraction of erythromycin instead of the traditional method of forced separation. This amounts to an important reform in medicine manufacturing, which can achieve an extraction rate of 99 percent and attaining advanced quality standards in the product. The Ministry of Aeronautics adapted the refrigeration technique for aeronautical turbine expansions to recovery of light hydrocarbon in oil fields and last year provided the Ministry of Petroleum Industry with 24 devices, which, after being put to use, can handle oil field gas up to 1.4 billion cubic meters and earn over 100 million yuan. The Ministry of Aeronautics also developed, together with the

Shaanxi Provincial S&T Commission, a pneumatic spinning and spray weaving machine of the international advanced standards of the 1970's and thereby helped bring about a radical change in the backward state of the spinning and weaving industry. The assembly line for colored TV sets, designed by the Ministry of Aeronautics for Tianjin, compares favorably in suitability, stability, and reliability with the imported ones in use in China and cost only one-half of what was invested in the imported ones, saving US$2.1 million of foreign exchange. In support of the technological transformation in the light and textile industries, departments of the defense industry developed and manufactured up to 100 items of equipment, such as transverse knitting frames, leather shoe making machines, oil presses, bread baking production lines, food ovens, corrugated board production lines, cigarette manufacturing machines, beer production lines, etc. The Ministry of Ordnance Industry utilized its own technological strong points to design and manufacture almost 100 specialized types and models of equipment for 16 branches of industry, such as the leather, cigarettes, rubber, textiles, paper, and tea producing industries. The more than 600 items of equipment supplied by them to the Chongqing civilian industry enabled that area to increase annual production value by 50 million yuan.

2. Helping the civilian industry adapt and integrate imported technologies and providing main spare parts to maintain imported chemical fiber plants, steel rolling mills, and other plants. Chemical fiber plants and rolling mills imported by China as complete plants require every year a large amount of spare parts. Some of these parts demand high technology and complex techniques to manufacture, and China relied in the past on their importation. Departments of the defense industry have now energetically undertaken development and manufacture of many of the key parts, ensuring regular and continuous working of the imported equipment and saving large amounts of foreign exchange for the state.

3. Utilizing the superiority of defense industry technology to overcome key problems in civilian technology. For instance, the 220 kV high-tension low oil hydraulic circuit breaker, has been a long-standing problem that could not be solved domestically, and several key civilian factories and research institutes tried to tackle the problem, spending up to 1 million yuan without success. After the China Shipbuilding Corporation took on the project, it designed a comprehensive technique, work installations, and test stand, manufactured up to 100 models, and accomplished the development of this entire project of 1,152 components of various kinds, requiring high precision working and exactly closing seals. It was later installed at all the major power networks of the country, including those in Beijing, Shanghai, Chengdu and at the Anshan Steel Works. Its quality was not inferior to imported articles of this kind, and it eliminated all safety concerns regarding the operation of high voltage switches on power transmission networks; the savings in foreign exchange amounted to over US$2 million. Manufacture of the hydraulic equalizing vat on the 1.7 meter rolling mill of the Wuhan Steel Works, a key item on the hot steel rolling line, was attempted by over 10 factories, all without success. After the Ministry of Aeronautics took on the task, it successfully developed the part and installed it for use in somewhat over 3 months. Its quality is better than the Japanese product and

its manufacture has resulted in saving the state up to US$1 million of foreign exchange. In recent years, the defense industry provided China's medical and public health services with sets of comparatively advanced medical equipment and research achievements, and is now in the process of developing a set of new technology-intensive items of equipment for the medical and public health services. The Ministry of Nuclear Industry used isotope and irradiation technology for various kinds of clinical diagnoses and medical treatments, and also found wide use for this technology for breeding purposes in agriculture and for food storage. The defense industry is now expending much effort on the development of robots, microelectronics and other such new industrial fields.

4. Providing technological counselling and technological services, helping civilian enterprises enhance their technological and managerial skills. The Shenyang loudspeaker factory and the Wuxi Qianzhou machine building plant obtained, by tying up with units of the defense industry, technological counselling and the service of S&T personnel of the defense industry enterprises and research institutes, and were thereby able within a comparatively short time to establish a personal post responsibility system, as well as to perfect their system of quality controls, and to improve performance of basic work in the various technologies, thereby becoming able to turn losses into profits, and transform backwardness into an advanced state of production. There are now many civilian enterprises which consider the strength of the defense industry as a force backing their own operations, and many of them have established long-term cooperative relations with units of the defense industry.

In short, experiences in China and in many countries of the world show that the transfer of defense industry technology to civilian uses promotes integration of S&T with production, that it is an effective way to raise the level of social productive forces, and will, furthermore, have a far-reaching influence on the development of the defense industry and of the national economy. Forms employed to transfer defense technologies to civilian uses can roughly be divided into the following categories: First, contracting for the completion or continuation of entire large-scale key projects or engineering tasks, or for parts of them, for instance, for the supply of entire plants, or finished products, various kinds of large-scale production lines, power generating plants, locomotives, mining machinery, or motor vehicles. Second, transfer of technological achievements. Third, transfer of technological software together with its hardware, which would include transfer to the civilian sector of actual products as well as their manufacturing technology. The methods would also include a variety of forms of transferring defense technology to civilian use, such as joint development, operation with joint capital investment, etc. Fourth, taking on and assisting civilian manufacturing enterprises in digesting and adapting various imported technologies. Fifth, having defense industry S&T personnel provide various kinds of technology services for the general public. The widespread development of this type of work has had a positive, stimulating effect on the rise and prosperity of the domestic technology market, and the gradual prosperity of the technology market has also vigorously stimulated transfers of defense technologies to civilian uses. At the same time, while serving the growth of

the national economy, this development has improved and consolidated development of defense industry technologies, and brought defense S&T to a new phase of initiating service to the national economy, on a broad scale and in depth, with main stress on transfers of technologies, using a variety of forms suited to different levels, and working through a variety of channels. All this activity is carried out on the premise of fully ensuring completion of its own ordnance and equipment development and production tasks.

To sum up, in the last few years, the defense industry has truly made definite progress in transferring defense technologies to the civilian sector. However, there is still much potential in defense technology, which is a long way from being fully utilized. The S&T departments of the defense industry could, to a much larger extent, undertake further tasks with regard to the design, development, and production of technological equipment needed in key projects of national construction, with regard to technological transformations in key state enterprises or trades, in the digestion of major imported technologies, in adaptations and new creations, in opening up new fields of technology, and in developing new types of products. Special attention must be paid to effectively develop large technological achievements of advanced domestic or world standards, which can yield good economic results. At the same time, the export of technological products of superior quality must be effectively organized, and vigorous efforts must be made to open up the international technology markets.

Transferring defense technologies to the civilian sector is a strategic policy with the purpose of accelerating growth of the national economy and of invigorating S&T in the defense industry. Relevant departments, regions, and units in the industrial and commercial enterprises of the defense industry, when determining their multilevel development strategies, programs, and plans, must all give overall consideration to the problem of transferring defense industry technologies to civilian use. After further studies of the characteristics and laws of technology transfers, and after attaining a good command of them, it is necessary to establish an institutional system, as well as a policy, rules and regulations, for the transfer of defense technologies to the civilian sector. It is also necessary to effectively solve the problems of funds and channels for goods and materials. May the work of transferring defense industry technologies to the civilian sector develop and advance smoothly and effectively.

9808/6091
CSO: 4008/7

CHAPTER 3. INSTITUTION OF THE PATENT SYSTEM

[Text] In order to protect the patent rights for inventions and creations, encourage inventions and creations, facilitate the popularization and application of inventions and creations, promote the development of S&T, and adapt to the needs of the socialist modernization, the SSTC, together with other relevant departments, began in 1978, with the approval of the CPC Central Committee and the State Council, to investigate and study the institution of a patent system. In 1980, a State Patent Bureau was established, and in March of 1984, the Standing Committee of the NPC passed the "Patent Law of the PRC (Draft)," which came into force on 1 April 1985.

By the end of 1985, 14,372 patent applications had been received, and 143 patents had been approved. The implementation of the patent law provided favorable conditions for the development of intellectual wealth in China and injected new vitality into China's scientific, technological, and economic development.

1. A Patent Law With Chinese Characteristics

In the course of drafting China's patent law, attention was paid, especially as to its legislative form and procedure, to absorbing certain favorable experiences of foreign countries, as well as to observing the common principles that have to be observed according to the provisions of the Paris Convention for the Protection of Intellectual Property. However, even more importantly, the realities of China were the starting point in drafting the law, so as to make it a socialist patent law with Chinese characteristics.

Inventions and creations are the products of human creative intellectual work, the result of socialized intellectual work, basically endowed with commodity value and use value, and of the general nature of wealth. In addition, inherent in inventions and creations is the objective need for compensation in value and information exchanges. The state, of necessity, has to provide legal protection for them. The current Chinese patent law, therefore, as its legislative task, appropriately regulates the relationships between the inventor or creator, the owner of the invention or creation, and the user of the invention or creation.

As to handling patent rights, the patent law started out from the reality of Chinese conditions and the multiplicity of socialist components of the

economy, such as ownership by the whole people, ownership by the collective, and individual ownership, and decided to deal with each case in different ways. In Article 6, paragraph 2, the law prescribes: "With respect to work-related inventions and creations completed by personnel working for foreign enterprises or Chinese-foreign joint venture enterprises within China, the right to apply for patents shall belong to such enterprises; the right to apply for patents for inventions and creations which are not work-related shall belong to the inventor or the designer. After the application has been approved, the patent shall be owned by the enterprise or the individual that made the application." Whoever obtains the patent right, regardless of whether an enterprise or an individual had applied, shall enjoy the patent rights described in Article 11, namely: "Except as provided under Article 14 of this law, after an invention patent or a utility model patent has been granted, no unit or individual may enforce such patent, that is, may manufacture, use or sell the patented product or use the patented method for the purpose of production or operation, without the permission of the patentee." "After a design patent has been granted, no unit or individual may enforce such patent, that is, may manufacture or sell a product incorporating the patented design for the purpose of production or operation, without the permission of the patentee."

Article 6, paragraph 1, of the Patent Law provides: "In the event that a unit under the collective ownership system or an individual was the applicant, the patent shall be owned by the unit or the individual." However, Article 14 provides for a system of approval for use in accordance with the state plan. In the case of patent rights of Chinese units under the collective ownership or of an individual, this approval for use according to the state plan is limited to patents that are "of great significance to the national interest or the public interest and the application of which needs to be widely popularized." To prevent misuse of this type of patent approval for use in accordance with the state plan, the patent law stipulates a strict procedure for their examination and approval.

It is further stipulated in Article 6, paragraph 1: "After an application has been approved, the patent shall be held by the unit, in the event that a unit under ownership by the entire people was the applicant." However, Article 14, paragraph 1, stipulates: "The relevant departments in charge under the State Council and people's governments in provinces, autonomous regions, and directly administered municipalities shall have the power to decide, in accordance with the state plan, that designated units may be permitted to enforce important invention and creation patents held by units under the ownership by the entire people that are within its own system or under its jurisdiction. The working units shall, in accordance with state stipulations, pay royalties to the units holding the patents." The patent law describes patent ownership obtained by units owned by the entire people as "holding the patent," which conforms with the practice in case of property rights the state has granted to units owned by the entire people. The arrangement has the beneficial effect of expanding enterprise autonomy. The unit owned by the entire people which had its patent subjected to "approval for use according to the state plan," may, apart from obtaining economic compensation, still, according to the patent law, transfer the patented

technology to units outside the scope for which "approval for use according to state plan" had been given, and this includes transfers, with due approval, to places abroad.

Many countries have provisions about "confiscations by the state," but not so under Chinese patent law. With regard to compulsory licensing, the Chinese patent law has some strict provisions. According to the provisions of the Chinese patent law, a compulsory license can be obtained only in the following two contingencies: 1) If the patentee, within 3 years after approval of his application, does not fulfill the obligation to use the patent. 2) In the case of mutually linked patent use [if use of a later patent depends on the use of an earlier patent]. Article 57 of the Chinese Patent Law prescribes: "The unit or individual that has been granted a compulsory license to enforce a patent shall pay a reasonable royalty to the patentee, the amount of which shall be agreed upon by both parties. In the event that the parties fail to reach an agreement, the State Patent Bureau shall adjudicate." A party dissatisfied with the decision of the bureau may appeal to the people's court.

As demanded by China's S&T development, the patent law gives a scientific description of the patentability of inventions or creations, in that it stipulates that "the invention or utility model must have novelty, creativity, and utility." This conforms with conditions for patentability of inventions and creations in many other countries.

As to novelty, the Chinese patent law basically agrees with provisions in the laws of the United States, Japan, and other countries, in that it specifically prescribes: Novelty is to mean "that prior to the date of application no similar invention or utility model has been published in publications in China or abroad, no similar invention or utility model has been publicly used in China or otherwise come into public knowledge, and no application for a similar invention or utility model has been filed with the State Patent Bureau by any other person and is recorded in patent application documents published after the date of application."

As to creativity, the patent law prescribes that it means that "compared to the technology that existed prior to the date of application, the said invention possesses outstanding substantive characteristics and is a marked advance, or that the said utility model has substantive characteristics and represents progress." As to utility, "that the said invention or utility model can be manufactured or used, and can produce positive results." These provisions are somewhat different from those in Europe and the United States. The laws of Europe and the United States are using as criterion for creativity that the invention must not be of an "obvious" nature, and consider creativity as given "if the invention is not of an 'obvious' nature to a person familiar with that branch of technology." The Chinese patent law determines the creativity of an invention or utility model according to two criteria, namely the substantial characteristics of the invention or creation, and its progressive nature compared with presently available technologies.

The provisions of the patent law regarding usability not only emphasize its practicality, which means, that it "can be manufactured or used," but also that it "can produce positive results," meaning, that it will play a positive role for progress of humanity and society.

In view of the broad mass base in China for utility models and designs, the patent law attaches the same importance to them as to the treatment of inventions. In its scope of protection it is similar to the patent laws of most countries of the world. The Chinese patent law also adopts a policy of selective protection. Article 25 of the Patent Law stipulates that patents shall not be granted for scientific discoveries, rules and methods of intellectual activities, methods for the diagnosis and cure of diseases, food, beverages and seasoning, pharmaceuticals and substances derived from chemical processes, animal and plant varieties, and substances obtained by means of nuclear transformation. However, patents are granted for the production processes of food, beverages and seasoning, pharmaceuticals and substances derived from chemical processes, and animal and plant varieties. Due to China's limited experiences in the short time since the initiation of the patent system, the range of items for which it is not possible to obtain patents may still, after further practice, be adjusted.

The "Enforcement Regulations for the Patent Law of the PRC (Draft)," which were approved and published by the State Council on 17 January 1985, came into force on 1 April, together with the patent law.

The enforcement regulations are based on the patent law and set forth specific rules for the implementation of the patent law. Article 2 of the regulations defines the three objects of patent protection: inventions, utility models, and designs. Applicants are in this way given clear and definite directions, and agents as well as examining personnel are also provided with rules to follow in their work.

The regulations contain detailed provisions on each of the procedures for applying, examining, and approving patents, such as the procedure for submitting an application, the procedure for examining applications and deciding on them, items to be attended to when acting on requests for compulsory licenses, and what fees to pay for patent applications and applications for substantive examinations. The regulations also prescribe that every professionally employed inventor who obtains a patent should be granted a reward by his unit in the following three ways:

(1) After obtaining its patent, the unit holding the patent shall give a reward to the inventor or designer. The reward for a single invention patent shall be at least not less than 200 yuan, and in case of a reward for a utility model or design not less than 50 yuan.

(2) The unit holding a patent shall, during the validity of the patent and after taking the patented invention or creation in use, set aside from 0.5 to 2 percent of the net, after-tax profits derived from the use of the patent or use of the utility model, or from 0.05 to 0.2 percent from the net after-tax profits from the use of the design, to be given to the inventor or designer as remuneration.

(3) If the unit holding the patent allows another unit or individual to use the patent, 5 to 10 percent of the after-tax royalty shall be set aside to be given to the inventor or designer as remuneration.

All these regulations underlie the importance China attaches to the progress of S&T and the concern for the interests of the large contingent of S&T personnel.

In support of an effective implementation of the patent law, a whole series of other relevant measures and provisions have been drawn up. These include: "What To Know About Patent Applications," "Schedule of Patent Fees," "Measures for the Reduction and Deferment of Patent Application Fees From Individuals," "Procedure and Work Flow for Checking Invention Patents," "Procedure and Work Flow for Checking Utility Models," "Procedure and Work Flow for Checking Designs," "Rules on Administration of Patents," "Rules on Handling Substantive Examinations," "Rules on Handling Challenges," "Rules on Handling Declarations of Patent Invalidity," "Criteria for Examination of Invention Patents," "Criteria for Initial Examination of Utility Models," "Criteria for Initial Examination of Designs," "Measures Governing Patent Applications by Chinese Units or Individuals With Foreign Participation," "Provisions on Starting Patent Adjudications by the Supreme People's Court," "Measures for the Preservation of Microorganisms Used for Patent Procedures," "Provisional Regulations Governing Importation and Quarantine of Species of Microorganisms and Bacteria (Poisons) Used in Patent Procedures," etc. These provisions and measures have already been promulgated and have come into force. The "Tentative Provisions Regarding Patent Agencies," after approval by the State Council, were promulgated on 4 September 1985, and have come into force. With all these regulations, China has basically done all in its legal provisions to complete preparatory work for the implementation of the patent law.

2. Progress in Patent Affairs

Since China's patent law came into force on 1 April 1985, progress has been smooth, and conditions are very good. According to statistics, up to the end of 1985, the China Patent Bureau received 14,372 patent applications; 9,411, or 65.5 percent, were domestic applications, and 4,961, or 34.5 percent, were foreign applications. According to the three categories: 8,558, or 59.5 percent, were applications for inventions; 5,174, or 36 percent, were applications for utility model patents; and 640, or 4.5 percent, were design patents. On 10 September, the China Patent Bureau published the first issues of its Gazette of Invention Patents, Gazette of Utility Model Patents, and Gazette of Design Patents, announcing China's first lot of approved invention patent applications, and also of utility model patent and design patent applications that were found up to standards on initial examination. The bureau also published the first lot of public explanations of invention patent applications, also explanation of the results of examinations, and explanation of utility model patent applications. In this way, China started its own patent literature and enriched substantially the international treasure-house of patent literature. With the passage of time, China's patent technology literature will reach perfection, to play an important role in China's development, dissemination, and application of new technologies.

The first lot of patent applications that were published consisted of 150 items, of which 46 were invention patent applications, 65 utility model patent applications, and 39 design patent applications. Up to the end of December, the China Patent Bureau examined and approved China's first lot of 138 items, of which 40 were invention patents, 60 were utility model patents, and 38 were design patents, and a further lot of 5 items were secret defense patents.

In the following, we shall present progress made in handling patent affairs:

(1) Patent Examinations

Examinations are mainly handled by the examiners of the patent bureau. The China Patent Bureau has now a contingent of over 200 to do substantive examinations. They are all graduates from science and engineering colleges and universities, all have work experiences, are familiar with and knowledgeable regarding developments in their field of work, and have received training in patent law and patent examination affairs, so that they are well prepared to do patent examination work. To guarantee the smooth progress of patent examinations, the patent bureau has specially set up classified files to facilitate the necessary searching during patent examinations.

In substantive examinations the "responsibility system for examining personnel" is applied in principle. Examiners are employees as well as servants of the people and shall therefore make examination procedures as convenient as possible for applicants and their agents, render assistance, and establish new patterns of friendly cooperation between each other.

China adopts a system of advance publication and delayed examination.

According to the provisions of the patent law, invention patent applications have to undergo substantive examination. For utility model and design patent applications, the patent law requires only preliminary examinations. The advance publication of applications by the patent bureau has the purpose of giving the public an opportunity to raise objections to applications. These are the so-called "challenges," a kind of legal procedure. According to the provisions of the patent law, challenges may be filed within 3 months after a decision on an invention patent application, and after publication of a utility patent or design patent. Within this period, anybody may file a challenge with the patent bureau. According to the provisions of the patent law, anybody may file a request with the patent bureau to invalidate a certain patent even after the patent has been approved. If the applicant does not accept the decision of the patent bureau rejecting his application, he may request a reexamination by the patent reexamination commission. If an applicant will not accept the decision of the patent reexamination commission invalidating a patent or upholding a patent, he may file suit with the people's court within 3 months of receipt of the notification, according to Article 49 of the Patent Law.

(2) Patent Reexamination

The China Patent Bureau set up a patent reexamination commission in November of 1984 and drew up the necessary statutes and provisions, such as the "Statutes of the Patent Reexamination Commission," "Rules Governing Patent Reexamination," "Rules Governing Invalidation of Patents," "Provisions Governing the Verbal Procedure for Reexamination and Declaration of Invalidation," and others. The main tasks of the commission are:

1) Hearing and deciding on appeals against the decision of the Patent Bureau rejecting a patent application, if reexamination is requested according to law. The "rejections" comprise rejections on preliminary examination, rejection on substantive examination, and on examination of an opposition.

2) Handling and deciding on petitions, submitted according to law, to declare a certain patent invalid.

3) In the event a suit is filed with the people's court according to law by a party who does not accept the decision of the reexamination commission denying a request for reexamination, or the decision of the reexamination commission declaring a patent invalid, the reexamination commission has to appear in court as defendant in the suit.

Establishing the reexamination procedure is to prevent rejection of applications that actually should have been approved, and establishing the procedure of invalidating patents is to rectify cases in which patents should not have been granted. The procedures for reexamination and for examination of oppositions complement and supplement each other, have a beneficial effect on improving work quality, and prevent mistakes in examinations and approvals. They effectively guarantee the legitimate rights of applicants and the interests of the general public, and contribute to increased enthusiasm for inventions and creations. They are the concrete guarantees for an effective implementation of China's patent law and its enforcement regulations, and they are also an indispensable major factor in the establishment and development of China's patent system.

(3) Patent Adjudication

As early as 1985, the Supreme People's Court drew up clear and definite provisions governing the adjudication of patent disputes, regulating such matters as the scope, jurisdiction, court procedures and criminal procedure in such cases. There are, according to these provisions, seven categories of patent cases that are to be adjudicated by the economic tribunals of the people's courts:

1) Disputes whether an invention patent should be granted;

2) Disputes whether an invention patent already granted should be declared invalid or upheld;

3) Disputes regarding execution of a compulsory license;

4) Disputes regarding the amount of royalty in the case of compulsory licenses;

5) Disputes regarding expenses for use of the invention, utility model, or design prior to granting the patent, after publication of the patent application;

6) Cases of patent infringements (including unauthorized use of someone else's patent, but not yet constituting a criminal act);

7) Disputes over transfer of right to apply for patent or over patent contracts.

(4) Documentation of Patents

The China Patent Bureau now has over 10 million patent documents in its custody, and the amount of documents held by over 20 local units has reached 80 million. These documents are kept according to serial numbers, are generally open to the public, and constitute the foundation for the institution of patent work in China, for the transfer of technologies against remuneration, and for the interchange of technological information.

In 1983, the Patent Bureau set forth the policy of rendering the patent documentation "more Chinese in character, more specialized, microformed and computerized" and proposed a classified way of handling. There is now an international patent classification (IPC), and the patent documents in the United States and European patent bureaus and those of the patent convention are already filed according to the IPC classification, which can initially meet the needs of patent examiners.

Through several years of effort, the initial structure of a nationwide patent documentation service system has been established. As the first group, there are 64 network outlets of the patent documentation service spread over all provinces, municipalities, and autonomous regions, which create convenient facilities which allow the general public to examine any patents without having to go far and to obtain the latest technological information.

(5) Adjustment of the Patent Organization

Since its establishment in 1980, the work at the China Patent Bureau has made great progress. The number of staff and workers at the bureau exceeds 1,000. The bureau has 11 departments, among them: examination departments Nos. 1 to 5, legal affairs department, general administrative department, personnel and educational department, patent documentation service center, and patent documentation publishing agency.

A branch bureau has been set up in Shanghai, in charge of accepting patent applications, starting a patent cadre training college, and develop research in the field of patents. Furthermore, patent agencies have been set up at Shenyang, Jinan, Changsha, Chengdu, and Nanjing, mainly to assume responsibility for accepting patent applications.

According to the provisions of the patent law, China will set up patent administrative organs and patent service organizations all over the country. There are already 94 patent administrative bureaus (offices) in various departments of the local administration, and almost 300 patent service centers or patent offices. There are three agencies handling affairs involving foreign parties, namely the patent agency of the China International Trade Promotion Commission, the China Patent Agency (Hong Kong) Ltd., and the Shanghai Patent Office.

At the same time, several scholarly people's organizations have come into being one after the other. On 20 August 1982, the China branch of the International Federation for the Protection of Industrial Property was established, with a branch being set up at the China International Trade Promotion Commission. A China Federation of Inventors has also already been formed. On 29 March 1985, the China Industrial Property Research Association was established in Beijing, with its head office in the China Patent Bureau.

3. Prospects of Patent Affairs

Patent affairs in China show initial successes and progress continues smoothly. However, there are still problems, mainly:

(1) Patent affairs are not yet receiving fullest and widespread attention, and work is not proceeding evenly throughout the country.

(2) Patent applications show an imbalance; comparatively few applications come from large and medium-sized enterprises, and few patent applications are employment related.

(3) Documentation of patent applications is rather poor, some require rewriting and supplementing. This not only wastes the time of applicants, but causes inconveniences and difficulties in patent examination and approval work.

We intend to adopt the following measures in future patent work:

(1) Increase Publicity, Enhance General Knowledge

Establishing the patent system and instituting patent work is part of the reform of the economic system in China. By a variety of means, such as television, broadcasts, newspapers, and periodicals, this principle must be repeatedly publicized, and as many people as possible, especially leading cadres at all levels, should gain accurate knowledge of China's new patent system. They should energetically support patent work in their own regions and within their own departments, and achieve a conscientious and effective implementation of the patent law.

(2) Training of Cadres, Enhancing Competence

The contingent of patent cadre, consisting of examiners, judicial officers, agents, and administrative personnel, constitute the nucleus in China's new

patent system. Patent cadres require not only a certain professional knowledge, according to the different work they do, but also a certain Chinese literacy, legal knowledge, and foreign language facility. The Patent Bureau plans to cooperate with all local departments in adopting various forms of training patent cadres and to continuously raise their professional competence.

(3) Effective Handling of Documentation, Good Logistic Support

Patent documents are technical data as well as legal documents, which are of greater authority than other technical data. To accelerate the establishment of a patent documentation service system, the Patent Bureau has proposed to use computers and other advanced equipment to establish a database and have search terminals all over the country, also to use advanced communication technology, to satisfy user demand for remote search facilities.

First, we should set up a comprehensive nationwide patent documentation service network, consisting of a China patent documentation center, various branch centers, and China patent documentation service network outlets.

Second, we should establish two sets of world patent documentation, ten or so very basic sets of patent documentation and several hundred sets of Chinese patent documentation in the custody of the China patent documentation service center and branch centers, various local branch centers and various service network outlets, which all should be available to the general public.

Third, we should establish a well-trained patent intelligence contingent. This contingent must not only be knowledgeable about documents, but should also master a certain amount of S&T and patent knowledge, and be capable of modern administrative techniques and of taking on service work.

(4) In-Depth Research, Improving Work

Following the implementation of the patent law, many new problems will arise. These new problems and trends require intensified investigation, in-depth research, and prompt adoption of appropriate measures and methods to resolve the problems.

In the last 1 or 2 years, many countries adapted to the new technological revolution in the world by reforming to varying extents their industrial property systems. We must pay close attention to these new tendencies and derive from them valuable lessons. At the same time, we must start to explore the possibility of protecting in China new products among pharmaceuticals, food, chemical substances, and computer software, as preparation for a more perfect patent law in China.

(5) Expanding Contacts, Promoting Interchanges

China is a member of the UN World Intellectual Property Organization as well as a member of the Paris Convention on the Protection of Industrial Property.

This not only shows that we have an international obligation to protect industrial property, but, more importantly, that a broad channel has been opened up for the development of friendly cooperation between China and world circles interested in the protection of industrial property. In the course of setting up a patent system, China is establishing excellent cooperative relations with many countries, and is gaining many valuable lessons from their practice. Since enforcement of the Chinese patent law, more than 30 countries and territories have applied for patents in China. This is undoubtedly beneficial for China's importation of technologies. We are determined to make good use of this favorable opportunity to further develop friendly contacts with various countries, promote technological interchanges, and contribute our strength to the success of the protection of industrial property.

Table 1. Numbers and Proportions of Applications for the Three Categories of Patents (1 April to 31 December 1985)

Unit: Item

Type		Domestic		Foreign		Total	
		(1)	(2)	(1)	(2)	(1)	(2)
Inventions	(3)	1520		382		1902	
	(4)	2545		4111		6656	
	Subtotal	4065	43.2	4493	90.6	8558	59.5
Utility models	(3)	3366		23		3389	
	(4)	1711		74		1785	
	Subtotal	5077	53.9	97	2.0	5174	36.0
Designs	(3)	192		43		235	
	(4)	77		328		405	
	Subtotal	269	2.9	371	7.4	640	4.5
Total	(3)	5073	54.0	448	9.0	5526	38.4
	(4)	4333	46.0	4513	91.0	8846	61.6
	Subtotal	9411	100.0	4961	100.0	14372	100.0

Key:
- (1) No. of applications
- (2) Proportion (%)
- (3) Not employment related
- (4) Employment related

Table 2. Domestic Applications and Agency Applications for the Three Kinds of Patents (1 April to 31 December 1985)

Region	Number of items handled									(1)	
	To-tal	(2)	(3)	De-sign	Among 3 types of applications					To-tal	Not employ-ment related
					(4)	(5)	(6)	(7)	(8)		
Beijing	1540	754	720	66	674	347	368	118	33	839	106
Shanghai	806	374	406	26	389	119	159	127	12	435	112
Liaoning	718	304	412	2	352	97	107	142	20	529	197
Jiangsu	688	240	436	12	388	164	61	63	12	240	69
Hunan	606	190	405	11	378	51	80	84	13	254	138
Tianjin	473	209	226	38	288	92	36	42	15	274	116
Shandong	436	145	281	10	255	39	61	66	15	224	89
Sichuan	416	196	203	17	213	96	54	48	5	197	57
Heilongjiang	361	156	201	4	247	31	34	45	4	164	75
Zhejiang	355	144	210	1	227	70	23	31	4	159	62
Hubei	336	195	132	9	113	121	52	45	5	199	32
Jilin	325	138	185	2	166	41	87	17	14	196	67
Shaanxi	302	147	153	2	141	98	32	27	4	168	39
Henan	293	132	158	3	183	22	36	41	11	101	45
Guangdong	286	128	136	22	147	42	30	54	13	133	36
Hebei	243	81	160	2	157	10	31	37	8	123	56
Jiangxi	164	52	102	10	116	18	7	17	6	54	31
Guangxi	159	45	99	15	124	4	8	20	3	46	31
Shanxi	140	67	70	3	79	14	31	14	2	77	24
Fujian	137	74	63		90	16	21	8	2	64	28
Yunnan	135	66	65	4	59	27	25	22	2	86	26
Gansu	135	66	69		81	9	16	17	12	49	14
Anhui	118	44	72	2	78	6	28	5	1	35	10
Guizhou	86	43	37	6	49	1	13	19	4	41	13
Inner Mongolia	76	42	32	2	45	1	17	11	2	40	14
Xinjiang	36	20	16		22	2	8		4	17	9

Ningxia	26	4	22		11		8	2	5	23	9
Qinghai	14	8	6		5		4	4	1	11	4
Taiwan	1	1			1					1	1
Tibet											
Total	9411	4065	5077	269	5078	1538	1437	1126	232	4779	1510

Key:

(1) Number of applications accepted from agencies
(2) Inventions
(3) Utility models
(4) Individuals
(5) Colleges and universities
(6) Research units
(7) Industrial and mining enterprises
(8) Government organs and organizations

Patent Applications Processed in Major Countries or Regions
(1 April to 31 December 1985)

Unit: Item

Country or region	Total	Inventions	Utility models	Designs	(1)	(2)
Japan	1729	1486	59	184	64	1665
U.S.	1235	1200	9	26	74	1161
FRG	509	493	5	11	49	460
Holland	232	230		2	10	222
UK	210	196		14	9	201
Switzerland	171	171			14	157
France	154	152		2	30	124
Hong Kong	121	37	15	69	50	71
Australia	90	86		4	25	65
Italy	86	75	2	9	19	67
Sweden	68	64		4	9	59
Denmark	57	24	2	31	16	41
Canada	53	49		4	10	43
Hungary	50	50			30	20
Austria	43	42	1		7	36
Belgium	27	24		3	2	25
Finland	22	22			2	20
USSR	5	5				5

Country or region	Total	Inventions	Utility models	Designs	(1)	(2)
Spain	4	4			2	2
Other	95	83	4	8	26	69
Total	4961	4493	97	371	448	4513

Key:
(1) Not employment-related inventions
(2) Employment-related inventions

9808/6091
CSO: 4008/7

CHAPTER 4. THE SETTING UP OF VENTURE CAPITAL

[Text] Venture investment is a new investment mechanism which combines scientific and technological achievements with commercialized production.

1. The Rise and Development of Venture Investment

Venture investment can turn the invention by a small group of people or even by one individual into a widely used commodity; it is a difficult undertaking with a high rate of failure. However, without high-risk venture investments, development of new technologies would hardly be possible. Once success has been achieved, this kind of investment is repaid several times over, even several tens or hundreds of times. Venture investment, therefore, first began to appear in the United States in the forties, where new technologies were emerging and abundant capital was available. By the 1960's, investment activity of this kind increasingly flourished and developed. Japan followed in America's footsteps and vigorously developed venture investment, which in the 1970's became common. Since the beginning of the 1980's, venture investment began to flourish in Western Europe and Southeast Asia. In China's province of Taiwan too, venture investment companies have sprung up. Now, venture investment has become a popular branch of the world's economy and finance.

2. Substance and Functions of Venture Investment

Venture investment is comprised of three factors: venture capital, the venture investment company, and the venture entrepreneur and his business organization.

Originally, venture capital referred to the supplemental capital of an enterprise, but is now generally taken to mean investment in a high-tech industry. Abroad, the four sources of venture capital are private capital, pension funds, funds of universities, colleges, and other institutions of this type, and capital of insurance companies or other large enterprises.

Venture investment companies are enterprises specializing in venture investments. They are substantially different from banks or insurance companies and fulfill an important role that banks and insurance companies cannot fulfill; they stake their investment on the success of failure of the pioneering company, without requiring insurance or security. They give

the pioneering company all kinds of advice and technological suggestions, introduce qualified personnel, and participate in the business and financial management of the pioneering companies, while banks merely provide capital and generally do not concern themselves with the personnel and business conditions of the enterprise to which they lend. Banks are concerned about repayment of their capital and its interest.

A special feature of venture investment is that the investor and the party receiving the investment both jointly bear risks, share profits, and jointly endeavor to achieve the best possible economic results for both parties. This has the beneficial effect of encouraging enterprises to undertake the commercialization of those very complex most recent technological achievements.

Venture enterprises, aiming at special needs of customers, are often apt at commercial development of low-level usages for high-tech achievements, and are, therefore, enterprises that turn new technologies into new commodities for which there is a market demand. Such enterprises must be of a highly adaptable and technology-intensive nature, and are, therefore, frequently medium and small enterprises. In the operation of venture investments, the most important and critical factor is the selection of the venture enterprise manager. In certain developed countries, whole networks of venture enterprises have sprung up with horizontal linkages and having universities and scientific-technological organizations as their core, to integrate S&T closely with production, to turn collective advantages to good account, and by using the lever of venture capital to quickly convert new technological achievements into commercialized productive forces. They have become a general dynamic force in the economic and social development.

3. The Significance of Starting Venture Investments in China

In China, many scientific and technological achievements cannot be rapidly converted into commercialized production. One of the major reasons for this shortcoming is the method of long standing of having scientific research and development funds distributed, level by level, by the administrative departments of the government. This method of administering and distributing funds frequently disregards the fact that the conversion of scientific and technological achievements is an intermediary link in industrial production, so that the method, as far as testing and putting into production are concerned, becomes the main obstacle for conversions of S&T to production and to a realization of economic results. Especially not taking note of the fact that there are risks involved in the conversion makes the former method ineffective in supporting the people's creative spirit and abilities.

China is now engaged in a comprehensive reform of its economic system. Only by gaining the ability to operate on the principles of the commodity economy and the law of value in a unified socialist market environment can the enterprises be spurred on in mutual competition to increase economic results, while efforts to increase economic results, on the other hand, will have to depend mainly on commercialization of new technologies. However, starting to operate new high-tech industries, using new technologies to transform

traditional industries, especially medium and small enterprises that number in the tens of thousands, involves accepting a comparatively high developmental and business risk, and for this reason these enterprises can hardly ever count on getting the funds they need. Therefore, what they need is venture investment.

Invigorating the financial sector is one of the major items in the reform of the economic system. On the one hand, the development of commodity economy aggravates the problem of insufficient capital. The enterprises must raise capital, but to have to rely solely on banks that are already unable to satisfy the present vertical-horizontal interlacing requirements of capital would mean obstructing the development of the commodity economy and the lateral ties between enterprises. On the other hand, since the autonomy of enterprises has been broadened and they have gained in vitality, since there has also been a rapid expansion of the rural economy, there has been an increase in dispersed idle social capital. Those who hold this kind of capital urgently require a capital market, where it would be absolutely possible, by the use of different forms of borrowing and loaning, to transfer large amounts of this idle capital and a portion of temporarily unused consumption capital into production. Facts prove that establishment of capital markets and designating certain cities as key financial centers can raise economic results of capital use and cause capital to flow unceasingly into directions that suit the development of the socialist economy toward high economic results. Following the gradual appearance in China of various kinds of securities, further invigoration of the financial sector should, apart from adjusting interest rates, also try out operating enterprises jointly by means of shares. Instituting venture investment could convert idle and scattered small amounts of capital into large active and concentrated funds that could be used for the development of new technologies and that would promote cooperation for the purpose of specialization in social production.

Reform of the labor and personnel system and the various policies to create enthusiasm among the intellectuals have already induced a large number of intellectuals with mastery of the new technologies to integrate study, laboratory, and workshop with the commodity market, to invigorate the economy and start out on a road of greater contributions to the mother country. What they need is precisely the support of venture investments that would support the pioneering of new undertakings.

Generally speaking, the difficulty in the development of China's economy is insufficient capital. However, on the other hand, there is widespread squandering of extra-budgetary funds. Merely by adopting appropriate measures, it would not be difficult to accumulate capital that could be used as venture investments, and to transfer capital that is wastefully used on unplanned capital constructions to the transformation of old enterprises by means of high technology. At the same time, as living standards improve, there is a rapid increase in the savings accounts of the Chinese people. The banks could lend part of these deposits to venture enterprises. Even though no stock exchanges have so far been set up in China, the lateral joint ties between enterprises (including relations between scientific research units, institutions of higher learning, and enterprises) are already providing possibilities for the investment and withdrawal of venture capital.

China has over the years accumulated many new technological achievements, which urgently await commercialization. A large part of them are suitable for use by medium and small enterprises and have great developmental potential. Sources of technologies for venture investment can be ensured in a variety of ways, such as through technology imports, technology transfers, and through technology markets.

The scope of traditional Chinese industries is very large, but equally large is the disparity in product quality, compared with advanced world standards. The technological transformation of traditional industries is therefore a protracted and arduous task. Venture investment could achieve much in this broad field.

China's medium and small enterprises number in the tens of thousands, and are still increasing. There is no shortage among their personnel of talents who master the new technologies. The technical equipment in some medium and small enterprises is first-rate in China. Looking to the future, these medium and small enterprises in China, through technological renovation and lateral cooperation, will be playing an important role in the national economy. However, because they are mostly economically too insignificant, their projects will not be included in the macroeconomic plans of the state, this factor and the technical difficulties and uncertainties in their operations, will make it hardly possible for them to obtain credit funds from the banks. For these enterprises, venture investment would provide most needed and timely aid.

The reform tends to eliminate restraints on the mobility of qualified personnel, and enterprises too will become entities more responsible for their own profits and losses. Implementing the system of contractual employment of cadres and specialized technical personnel is also bound to enhance the vitality of enterprises. All this will make it possible for venture investment to develop in China.

Venture investment in new enterprises will facilitate the creation of certain limited areas in China in which high-tech production would be concentrated. In these areas, certain venture enterprises may consciously organize networks of lateral ties for a faster interchange of technologies, of qualified personnel, and of information.

Venture investment in new enterprises will accelerate the technological renovation of China's medium and small enterprises.

Venture investment in new enterprises will play an important role in the process of establishing new technological industries with Chinese characteristics.

Venture investment in new enterprises will promote high-tech and financial cooperation between China and various countries of the world.

Venture investment in new enterprises will raise the zeal for invention among Chinese intellectuals, and will help catch up with the advanced level of the world's S&T.

4. China's Venture Investment Undertaking

The "CPC Central Committee Resolution on the Reform of the S&T System" points out: "Development of high technology, which is subject to rapid changes and entails comparatively larger risks, may be given support by granting establishment and pioneering investment."

In September 1985, the State Council officially approved the establishment of the "China New Technology Investment Enterprise Company" (CVIC).

The scope of business of the CVIC comprises the following:

It states in the "Permit To Engage in Financial Business," which the Chinese People's Bank issued the said company: The said company may engage in every form of investment in rmb or foreign currencies, including share capital investment and trust investment; it may engage in trust business in rmb or foreign currency, including the establishment of trust funds and granting trust loans; it may give financial guarantees for loans, contract performances, tenders, and contracting by medium and small enterprises for the development of new technologies; it may also, in accordance with state regulations, issue or act as issuing agent for shares and bonds, engage in the leasing of technological equipment and in every kind of consulting services.

In the "Permit To Engage in Foreign Exchange Business," issued by the State Foreign Exchange Control Bureau, it is stipulated: The said company may engage in the business of foreign currency trust deposits in foreign countries and in China; it may grant abroad loans in foreign currencies, and issue abroad or act as agent for the issue of remittances in foreign currency, foreign exchange investments, foreign exchange loans, granting short-term foreign exchange loans for leasing business, and engage in credit information and consulting services.

The main technological fields of investment of the said company are: information, biology, electronics, and new materials, subdivided into 42 special areas as integrated electro-mechanics, software industry, electronic components, instruments and meters, communications, medicine, food, microbiology, enzyme engineering, fermentation engineering, bio-electronics, sensitive materials, optical fibers, refractory ceramics, engineering materials, high polymer materials, new types of alloys, and information recording materials.

Geographically, the said company first concentrated its investment in the economically more developed areas of the Pearl River Delta of Guangdong Province, in Xiamen, Zhangzhou, and Quanzhou of Fujian Province, and Suzhou, Wuxi, and Changzhou in southern Jiangsu Province, as well as in the Beijing-Tianjin area, and also established stations in the special economic zones along the coast, in preparation of entering at an early date the international market and to lay the foundation for high-tech international investment business.

The said company divided its process of investing in projects into six stages: basic study, usability study, development study, industrialization experiment, commercial investment, and expanded production. The focal points in the last few years were the stages after the industrialization experiment of the new technological achievements.

The following is the procedure for applying for a venture investment:

The applicant must first submit a testimonial in writing from a reliable unit or individual with regard to the project for which investment funds are applied. Then, according to the demand of the venture investment company, he must first complete a "Questionnaire of Initial Examination of Project" (to be completed within 2 weeks); after approval on initial examination, again according to the said company's "Notice on Suggested Detailed Feasibility Study" and "Reference Outline of Detailed Feasibility Study (or business plan)" the applicant will have to undertake the technical and economic feasibility study (to be completed within 60 days). After the venture investment company will have received the above material, it will complete its assessment and notify the applicant of the assessment result within 40 days. After notification of assessment, the project may then go on to discuss investment conditions and procedures and draw up a management plan for the completion and development of the project.

9808/6091
CSO: 4008/7

PART V. ENVIRONMENT AND RESOURCES

CHAPTER 1. INTERNATIONAL COOPERATION

[Text] Science and technology are mankind's common wealth, and any country and people may study together and carry them forward. In the world today, the development of science and technology cannot be divorced from international scientific and technical cooperation and exchange. The opening up of international scientific and technical cooperation and exchanges has become an important path by which each country develops its science and technology, and scientific and technical cooperation relations have become one of the fundamental matters relating to modern international relations.

Developing international scientific and technical cooperation is also an important component of this country's open-door policy. Through developing international cooperation and exchanges with many countries around the world, we promote the catering of our science and technology to the world, and we have made a firm step in keeping up with the world. By basing ourselves on the needs of the restructuring, going with world currents, opening the door a little wider, and expanding the developing international scientific and technical cooperative relations, we will be sure to hasten the process of our drive toward socialist modernization.

I. A Survey of Developments

Over the last 36 years, China's international scientific and technical cooperation and exchanges have undergone a tortuous path to make great advances.

Before 1971, we had signed two-party scientific and technical cooperative agreements or protocols with Czechoslovakia, Romania, Hungary, the GDR, Poland, the Soviet Union, Albania, Bulgaria, Yugoslavia, Korea, Mongolia, Vietnam, Cuba, Algeria, Egypt, Indonesia, and Kampuchea. And we also began to establish scientific and technical exchanges with countries like India, Burma, Sri Lanka, Pakistan, Afghanistan, and Yemen. We began to set up scientific and technical exchanges with the peoples of some Western European countries and Japan.

Beginning in the 1970's, and especially from 1971, after we had regained our rightful place in the United Nations, we once again moved toward the international theater, gradually developing scientific and technical cooperation and exchanges abroad. We signed agreements for scientific and technical

cooperation with the Sudan, Mexico, and Pakistan. Beginning in 1972, we began annual agreements with Canada regarding scientific and technical exchange projects, and exchange visits in 1973 of Chinese and American scientific delegations, which was the first sign of Chinese and American scientific and technical exchanges.

Since 1978, with the development of our open-door policy, China's international scientific and technical cooperation broadened to include two-party scientific and technical cooperative agreements with the governments of France, Italy, West Germany, England, Sweden, the United States, the Netherlands, Australia, Denmark, Greece, the Benelux Economic Union, Japan, Norway, and Austria. And, based on agreements, we also signed counterpart agreements with many professional sectors, while cooperation between governments progressed greatly. For example, based on a scientific and technical cooperative agreement between China and the United States, we have already determined 350 cooperative projects within 24 areas. Through scientific and technical cooperative channels between the governments of China and Japan, 12 cooperative research projects have been decided.

There have been new developments in scientific and technical cooperation between China and Third World countries. In addition to those countries with which scientific and technical cooperative agreements have long been reached, many more countries have signed or resigned two-party scientific and technical cooperative agreements between our respective governments. These countries include Kampuchea, the Philippines, Bangladesh, Thailand, Libya, Argentina, Chile, Nigeria, Venezuela, Turkey, Colombia, Algeria, Brazil, Pakistan, Egypt, Iran, Sri Lanka, Cyprus, and Morocco. In addition to these, more than 40 countries have established scientific and technical exchange relations with this country to varying degrees. Between 1977 and 1984, China carried out a total of 963 cooperative projects with Third World countries (where China was responsible for 558 and other parties for 405), and where the total of technical aid specialists, observers, and trainees going back and forth was nearly 3,100 (the Chinese side receiving 1,600 and the other sides receiving more than 1,400 people).

Scientific and technical cooperation between China and Eastern European countries (Czechoslovakia, Romania, Hungary, East Germany, Poland, Bulgaria, and Yugoslavia) has gone from restoration to a stable development. Between 1977 and 1984, China carried out 1,071 cooperative projects with the aforementioned countries (the Chinese side was in charge of 502, the other sides in charge of 544, and 25 were jointly researched), while the number of specialists who were technical aides, observers, and participants in international conferences, training classes, and cooperative research, as well as trainees, who went back and forth totaled more than 3,400 (the Chinese side admitted more than 1,170, while the other parties admitted more than 2,230). Beginning in 1982, we restored relations with the Soviet Union regarding single-item scientific and technical cooperation, and from 1982 through 1984 both parties jointly carried out 23 scientific and technical cooperative projects, where a total of 133 specialists went back and forth to observe and participate in international science and technology conferences (the Chinese side admitted 65 people, while the Soviet Union admitted 68). In

December 1984, China and the Soviet Union signed scientific and technical cooperation agreements between the two governments, beginning a planned exchange of projects.

In addition to two-party scientific and technical cooperation between governments, there have been great developments in multi-party scientific and technical cooperation and exchanges between international science and technology organizations centered within the United Nations system. One after the other, China has sent governmental delegations to attend United Nations conferences for the promotion and development of science and technology, the United Nations conferences on new and renewable energy resources, the second United Nations conference on outer space exploration and peaceful utilization, and world energy conferences, as well as international conferences held by joint specialty organizations and other international scientific and technical bodies. Relevant scientific and technical organizations in China are part of 85 international science and technology organizations, and carry on broad multilateral scientific and technical cooperation and exchanges with scientific and technical circles in all countries.

During this period, the channels for scientific and technical exchanges between the Chinese and other peoples became broader and broader, and of more and more diverse forms. The Chinese Academy of Sciences, the China Science Association, and the Center for Chinese Scientific and Technical Exchanges, as well as science and technology sectors of all ministries and commissions and all provinces and municipalities, have all done a great deal of work organizing scientific research structures connected with foreign countries and production units to conduct rather effective cooperation and exchanges.

In summary, between 1979 and September 1984, there were about 2,700 cooperative exchange projects organized in accordance with agreements between China and other countries in the world, more than 40,000 people participated in this cooperation and these exchanges, of whom more than 22,000 were sent out by this country and more than 18,000 were welcomed by China. We also sent more than 9,700 people to participate in more than 4,000 international science and technology conferences held abroad. These numbers show that scientific and technical cooperation by China and foreign interests has attained a new scale and has entered a new stage of development.

II. Principles and Policies

Since the Third Plenum of the 11th CPC Central Committee, China has defined new principles for the new period of scientific and technical cooperation and exchange abroad: to thoroughly implement the open-door policy of China to the outside, to actively develop international scientific and technical cooperative and exchange activities on an equal footing, to study earnestly the advanced and appropriate science and technology of each country together with its science and technology management experiences to serve China's drive toward socialist modernization, as well as to make our own positive contributions during said cooperation and exchanges. By carrying out our internationalist mission we will promote scientific and technical advances in all

countries which will in turn benefit scientific and technical progress in all countries.

These are the long-term principles to guide us in developing our activities concerning scientific and technical cooperation and exchanges abroad. The following matters are contained within:

1. International science and technology cooperation and exchanges are important components of our open-door policy to the outside world and of our scientific and technical work. They are important channels for studying, absorbing, and assimilating advanced foreign scientific and technical achievements, are important aspects in China's overall foreign relations, and are friendly links connecting scientists and technicians in China with scientists and technicians throughout the world. They have important significance for advancing good will among citizens of all countries, for safeguarding world peace, and for stimulating the prosperity of world economies and science and technology.

2. International scientific and technical cooperation and exchanges must cater to the whole world, and we will develop this kind of cooperation and exchange with all countries that are friendly with us in a long-lasting, stable, and thorough manner. Be countries large or small, poor or rich, all have their strong points. We must draw in what is strong from all countries so that we may make use of it.

3. While developing international scientific and technical cooperation and exchanges, we must maintain the principles of equality and mutual benefit. Scientific and technical cooperation and exchanges for both sides should result in something coming in, something going out, a supplying of each other's needs, should suit the requirements of both sides, and should be concerned with the rights of both sides; in cooperation and exchanges, we should achieve equitable consultations, should learn from and help each other, give full cooperation to each other, and neither forcibly bestow on others nor forcibly take from them; during shared research, the achievements of scientific and technical cooperation and the benefits gained therefrom should be reasonably shared in accordance with the extent of contributions made by each side.

4. The earnest expansion of the scale and substance of international scientific and technical cooperation and exchanges should maintain multiple channels and multiple formats. Scientific and technical cooperation between governments is carried out under agreements for science and technology cooperation and exchanges signed by both governments, the funds and manpower for which can both be assured, the areas of cooperation can be broadened, the extent of cooperation can be increased, and the results from cooperation can be outstanding. Enhancing this kind of cooperation can promote the development of exchanges between peoples. When there are various forms of scientific and technical exchanges between peoples and those forms are flexible, strengthening scientific and technical exchanges between peoples can supplement inadequacies in official cooperation. Multilateral scientific and technical cooperation and exchanges can avoid being limited by relations

between the two sides, and can broaden friendships and deepen channels of thought as well. Through the different channels of the multilateral, the two-sided, the official, and the civilian can be obtained excellent cooperative results.

5. In developing international scientific and technical cooperation and exchanges, we must proceed from the actual conditions in this country, we must be practical and realistic, and we must strive for substantial results.

When choosing projects for cooperation and exchange, we should take into consideration the focal points and sequence of priorities through which a country develops science and technology and its economy, as well as being of aid to the formation of rational technology structures for this country.

We should pay special attention to those people who are in the front lines of science research and who are familiar with conditions as they go to participate in international scientific and technical cooperative and exchange activities. Strengthening an organization's management will realistically increase the applicability and dissemination of the achievements of international scientific and technical cooperation and exchanges.

In scientific and technical activities abroad, we should broadly develop friendships, extend more goodwill, pay attention to being industrious and economical, and oppose extravagance and waste.

6. In international scientific and technical cooperation and exchanges, we should make the most of China's superiorities. This will contribute to the promotion of world science and technology.

Today, although science and technology in China is somewhat backward, we do have our own superiorities. There is our traditional science and technology and scientific and technical accomplishments achieved in science and technology since the founding of our nation; in natural resources, we are rich in rare metals, energy resources, and seeds, as well as the number of animal and plant products; in terms of regions, we have very special topographies and landforms, etc. These can all make contributions to promoting the development of science and technology in any country.

III. Activities in 1985

The year 1985 was one in which China went further in its restructuring and opening to the outside. International scientific and technical cooperation and exchanges developed abruptly during restructuring and opening to the outside.

A. Multilateral Activities in Scientific and Technical Cooperation and Exchanges

1. We continued our participation in the major activities sponsored by relevant scientific and technical organizations of the United Nations, and conducted scientific and technical cooperation and exchanges with them.

These major activities included: In June 1985, Chinese delegates attended the 7th meeting of the United Nations intergovernmental commission on the promotion of development through science and technology, and continued to exert efforts to promote the establishment of a long-term science and technology funding system to implement the "Guidelines for Maintenance and Acceptance"; in March 1985, we participated in the consultative conference on new energy resources as convened by the committee on developing and using new energy resources and renewable energy resources, participated in the formulation of project planning for new energy resources, and jointly with relevant United Nations organizations initiated training classes in China for new energy resources; in October 1985, China and the United Nations committee on the peaceful use of outer space held jointly in Beijing a progress and applications conference on outer space science technology; we continued the full-scale cooperation begun in 1978 with United Nations educational, scientific, and cultural organizations, and in 1985 together with these organizations, our relevant departments continued the joint convening in China of a series of scientific and technical activities (for example, science and technology statistics training classes and new energy resources training classes); after China's formal entry in 1984 to the international atomic energy organizations, in 1985, in addition to attending the councils and annual meetings of organizations, we continued to organize and initiate cooperative activities in nuclear safety and personnel development classes, nuclear technology and aspects of its applications. In recent years, we have begun active cooperation with the Economic and Social Commission for Asia and the Pacific (ESCAP) regarding desert control, new energy resources, and housing, as well as the transfer of rights to technology. In April 1985, we joined with the United Nations ESCAP to hold in Beijing conferences on remote sensing applications and planning, management, and policy development; in October 1985, on the occasion of the 10th anniversary of the establishment of relations between China and Europe, a series of activities was held in China, such as conferences on science and technology policy. In October 1985, China and the United Nations ESCAP and the United Nations center for transnational companies held jointly in Fuzhou a "training class for improving discussion and management capabilities when developing countries are undertaking the transfer of rights to technology through transnational corporations"; at the 41st annual meeting of ESCAP convened in 1985, a draft resolution proposed by this country's delegation regarding policies, planning, and management for the promotion of Asian and Pacific scientific and technical advances was passed and proclaimed, and in 1986 a regional science and technology policy conference held in China will be subsidized. In addition, in 1985 China continued to participate in the United Nations University, as well as in scientific and technical cooperative activities held by UN grain and agriculture organizations, UN industrial initiation organizations, the World Health Organization, and the International Telecommunications Alliance.

2. We have encouraged and supported scientists and technicians in their planned and selective participation in science and technology conferences held abroad, and have actively created conditions to have a greater number of international science and technology conferences held in China. According to incomplete statistics, in 1985 scientists and technicians from China attended 573 international science and technology conferences held abroad

and 72 international science and technology conferences held in China, respectively. By attendance at these meetings and wide-ranging association with new friends, they can learn of some of the latest international scientific and technical information.

3. We have organized and participated in international science and technology fairs. In 1985, China participated in the Japan Tsunami International Science and Technology Fair. This fair was held from 17 March 1985 to 16 September, a total of 6 months. The theme of the fair was "mankind, housing, the environment, and science and technology." Forty-seven countries and 37 international organizations participated. The Chinese Embassy exhibited our ancient and modern achievements in science and technology, as well as traditional arts and crafts products, which were well received. During the period of the fair, the government delegation sent there participated in China Day activities on 17 May. At the same time, an observer delegation composed of 800 scientists and technicians was also sent there.

B. Bilateral Activities in Scientific and Technical Cooperation and Exchanges

In 1985, China convened bilateral science and technology mixed committee conferences separately with the 17 countries of Greece, the Philippines, Japan, the United States, East Germany, Thailand, England, Mexico, Korea, Romania, Hungary, Poland, Austria, West Germany, Yugoslavia, France, and Czechoslovakia, and also successively held mixed committee conferences on economics, trade, and science and technology cooperation with Turkey, Iran, Algeria, and Bangladesh. The basic situation regarding bilateral scientific and technical cooperation and exchanges between China and foreign governments is reflected in the series of working conferences mentioned below.

1. The second conference of the China-Greece mixed committee for science and technology cooperation

The science and technology cooperation agreement between the Chinese Government and the government of the Hellenic Republic was signed in November 1979. According to the sixth clause of the agreement, to observe the conditions under which the agreement is carried out and to confer regarding the next stages, the second meeting of the China-Greece mixed committee for scientific and technical cooperation was held in Beijing 4-5 February 1985. Through friendly consultations, both parties determined a group of new cooperative exchange projects pertaining to the professions and areas of building, energy, agriculture, biology, and chemistry, earthquakes, aquaculture, petroleum, geology, and computers.

2. The seventh China-Philippines conference on science and technology cooperation

On 14 March 1978, the two governments of China and the Philippines signed an agreement regarding Chinese-Philippine scientific and technical cooperation. The Chinese-Philippine conference on scientific and technical cooperation had met six times by 1984. The seventh conference was held in Manila on 6 March

1985. At the conference the cooperative projects for 1985 were discussed and determined. Our side took responsibility for nine Philippine projects, which deal with the special fields of medicine and hygiene, textiles, water conservancy, machinery, and varieties of fruit trees. The Philippines will be responsible for seven Chinese projects involving the specialties and fields of medical and health work, highway construction, comprehensive use of timber, and aquaculture.

3. The third conference of the China-Japan committee on scientific and technical cooperation

Since the two governments of China and Japan signed a Chinese-Japanese science and technology cooperation agreement in May 1980, both parties have cooperated in 12 projects in the fields of metallurgy, agricultural chemicals, science and technology information, computer standards, agriculture, and astronomy. Among these, applications of the cooperative research projects of refining technologies for columbite-bearing water and microbiology in the areas of the development of new agricultural chemicals and new pharmaceuticals have gained excellent results. There have been considerable developments in the scientific and technical cooperation between the two governments of China and Japan, from which certain achievements have also been obtained. The third conference of the committee on Chinese-Japanese scientific and technical cooperation was held in Beijing 5-6 April 1985. At the meeting, both parties made a joint review of the situation regarding scientific and technical cooperation as carried out under the science and technology agreement between the two countries, focusing their discussions on new cooperative projects. After consultation, 15 new cooperative projects were jointly determined. Both sides unanimously indicated that they would actively work to enhance and develop scientific and technical cooperation between the two governments.

On the first 2 days of the third conference of the committee on Chinese-Japanese scientific and technical cooperation (i.e., 2 April), the 1985 annual meeting for the technology cooperation between the governments of China and Japan (JICA channels) was held in Beijing. At the meeting, the technology cooperation planning for 1985 was discussed and determined, and they agreed after consultations that in the future they would develop cooperation in the area of the Japanese Youth Overseas Corps.

As for scientific and technical cooperation and exchanges between China and Japan, 1985 was a significant year. In this year, government officials from the two countries who are responsible for science and technology participated for the first time in a conference of Chinese and Japanese government officials held in Beijing in July, at which they had beneficial discussions; after a year and a half's consultations and discussions, the nuclear energy cooperation agreement was finally signed at the conference of government officials; at the invitation of the director of China's State Science and Technology Commission, the head of the Japanese Science and Technology Agency visited China, and both parties engaged in friendly discussions. Both parties felt that scientific and technical cooperation is an important component of friendly cooperative relations between the two countries, and that it is the

honorable duty of official science and technology departments in both countries to create the conditions for the expansion and development of scientific and technical cooperation between the two countries. Enhancement of Sino-Japanese scientific and technical cooperation will not only benefit the development of science and technology in both countries, but will also benefit the development of economic and trade relations between the two countries.

4. The fourth meeting of the joint committee on Sino-U.S. scientific and technical cooperation

On 31 January 1979, the two governments of China and the United States signed a science and technology cooperative accord to be in effect for 5 years. In keeping with the wishes of both parties, during his visit to the United States, Premier Zhao signed on 12 January 1984 an agreement to extend the science and technology cooperative accord between the two governments.

In the first 3 years of scientific and technical cooperation between China and the United States, both parties quickly expanded the fields of cooperation, and at the time of the second meeting of the joint committee on Chinese-American scientific and technical cooperation in October 1981, the areas in the cooperative protocol signed by both parties reached 17. At that time, counterpart departments were most concerned with determining cooperative planning, consulting on cooperative projects, meeting at bipartisan working conferences, and observing general directions. In recent years, cooperation has progressively developed such that counterpart departments from both sides have switched to carrying out cooperative planning and cooperative activities have gradually intensified.

Both parties agreed that there will be a meeting of the joint committee for Chinese-American scientific and technical cooperation about every other year, alternately being held in Beijing and Washington. The fourth meeting of the joint committee for Sino-U.S. scientific and technical cooperation was held in Washington 15-16 April 1985.

The joint committee reviewed the mutual exchanges of students and scholars since the third meeting, as well as accomplishments of cooperation in the 22 fields of agriculture, space technology, high energy physics, measurements and standards, atmospheric science and technology, aquaculture and fishing, hydroelectricity, earth sciences, earthquake research, environmental protection, basic science, building and urban planning, nuclear safety, surface water hydrology, nuclear physics and magnetically confined subatomic decomposition, aeronautical science and technology, shipping, science and technology information, industrial science and technology management, and statistics. They discussed the overall principles and particular problems of the relevant science and technology agreements, and exchanged opinions on future activities. During the period of this meeting, two new agreements were signed regarding cooperation in fossil energy and mapping.

After this meeting, while Chairman Li Xiannian was visiting the United States, the Chinese and United States governments formally signed after 3 years of negotiation and discussions, cooperative agreements in the

peaceful use of nuclear energy, and our State Education Committee and American news agencies signed an agreement for the mutual exchange of students and scholars. There were also expansions of bipartisan cooperative projects, three appendices having been added to cooperative projects in the field of mapping; two appendices in the field of statistics; and new projects also in other fields. And there was also a restoration of cooperation in Chinese-American agricultural science and technology.

5. The 13th meeting of the standing committee for Sino-East German scientific and technical cooperation

The agreement regarding technology and technical and scientific cooperation between the government of the PRC and the government of the GDR was signed in October 1953 in Berlin. The agreement was automatically extended for 5 years after its expiration. An extension of the agreement was signed again after that expiration in 1964. From 1953 through 1983, 11 meetings were held by the standing committee for Sino-German technology and technical and scientific cooperation. Both parties carried out more than 600 projects of exchange and cooperation.

The 12th meeting of the standing committee for Sino-German technology and technical and scientific cooperation was held in Beijing 24-26 April 1985. Thirty-eight projects were agreed upon at the meeting for 1985-1986 in the specialty fields of chemical engineering, mining, machinery, agriculture and animal husbandry, light industry, and medicine, with four projects being joint projects and eight being cooperative projects between the State Science and Technology Commission in this country and the GDR Ministry of Science and Technology.

Both parties have agreed that because in recent years scientific and technical cooperation has developed especially quickly between the two countries, agreements for scientific and technical cooperation between China and East Germany and regulations of the standing committee, both as signed in the 1950's, are no longer in complete accord with the actual current situation, and that there is a necessity to sign new scientific and technical cooperation agreements and regulations.

6. The sixth meeting for China-Thailand scientific and technical cooperation

The science and technology cooperation agreement between the PRC and Thailand was signed in March 1978. The sixth meeting of the mixed committee for Chinese-Thai scientific and technical cooperation was held in Beijing in May 1985. Both parties reached agreement regarding new cooperative projects after friendly consultation, that is, where the Chinese side will take on 26 projects for the Thais. In 19 of them, the Thai party will come to China for observation, two will concern training, and two will concern exchanges (exchange students and the Thai language), and three projects will provide seeds and hatchlings; the Thai side will take on 16 projects for China, including 14 for observation and two for exchanges (Thai language and exchange students).

The year 1985 is the 10th anniversary of the establishment of Chinese-Thai relations, and the delegation of the former Thai prime minister, Lu, came to China to attend the celebration activities. This was a symbol of the friendship between the two countries of China and Thailand, and symbolizes as well the development of cooperation between China and Thailand in the areas of politics, economics, culture, and science and technology.

7. The seventh meeting of the mixed committee for Chinese-Mexican scientific and technical cooperation

An agreement regarding cooperation in science and technology between the PRC and the Mexican Government was signed 9 September 1975 in Mexico City. From the signing of the agreement to before May of this year [1985], the mixed committee for Chinese-Mexican scientific and technical cooperation had held six meetings, both sides had joined to carry out 117 cooperative exchange projects, and 305 people had gone back and forth.

The seventh meeting of the mixed committee for Chinese-Mexican scientific and technical cooperation was held 27-30 May 1985 in Beijing. Both sides signed a summary of conversations of the seventh conference. After discussions and consultations at the conference, cooperation and exchange planning for 1986-1987 was determined. In all, 20 projects of cooperation and exchange were agreed to. Thirty people will go back and forth.

8. The fourth working conference for Chinese-United Kingdom scientific and technical cooperation

The agreement for scientific and technical cooperation between the two governments of China and the UK was signed in November 1978. From the signing of the agreement until before September 1983, the working conference for Sino-UK scientific and technical cooperation had been held three times, and a total of 28 cooperative projects had been carried out or were in progress. The fourth working session for scientific and technical cooperation between China and the UK was held in London from 18 May through 2 June 1985. Since the third session of the working conference, a total of 17 specialist delegations or groups from both sides had exchanged visits. These mutual visits have already or are in the process of leading to economic cooperation. At the meeting and after discussions, 19 new cooperation and exchange projects were agreed to for 1985-1986. Among them, 13 are to be carried out by the British ministry for trade and industry, three by the office of overseas development of the British ministry for foreign affairs, and three will be undertaken by the British Cultural Committee.

Signing the agreement for scientific and technical cooperation between the governments of China and the United Kingdom has promoted scientific and technical exchanges and cooperation between government departments, and according to incomplete statistics, relevant departments and units in this country have established relations with their counterpart departments and units in the United Kingdom, and have signed 21 agreements or memoranda for cooperation and exchanges with their counterparts. In 1985, a great number of scientific and technical exchanges were undertaken between corresponding departments and units.

9. The 25th session of the committee on Chinese-Korean scientific and technical cooperation

The agreement for scientific and technical cooperation between China and Korea was signed in December 1957 in Pyongyang. The 25th session of the committee on Chinese-Korean scientific and technical cooperation was held in Beijing from 28 May through 11 June 1985. During the meeting, planning for Chinese-Korean scientific cooperation in 1985 was discussed. On 11 June, both parties signed the conference protocol. According to the agreement, the Chinese side will take on 50 projects for Korea, while Korea will undertake 29 projects for the Chinese.

10. The 25th session of the committee on scientific and technical cooperation between China and Romania

The 25th session of the committee for Chinese-Romanian scientific and technical cooperation was held 4-11 July 1985 in the Romanian capital of Bucharest. A group of new cooperation and exchange projects were agreed upon at the meeting, and dealt with the specialties and fields of machinery, electronics, industrial chemistry, light industry, geology, coal mining, railways, agriculture and forestry, and medicine, as well as new energy resources. In 1985 there was an expansion of scientific and technical cooperation and exchanges between the two countries, and there were increases especially in joint research projects. Also signed at the meeting was a "summary regarding execution of a reciprocal exchange not involving foreign currency of specialists for Chinese and Romanian scientific and technical cooperation projects."

11. The 23d meeting of the joint committee for Chinese-Bulgarian scientific and technical cooperation

In March 1955, both parties signed an agreement for scientific and technical cooperation. From this time until October 1984, the joint committee for Chinese-Bulgarian scientific and technical cooperation met 22 times, both sides undertaking a total of 524 agreed projects.

The 23d session of the joint committee for Chinese-Bulgarian scientific and technical cooperation was held in Sofia 24-31 August 1985. At the meeting both sides exchanged views on how to strengthen scientific and technical cooperation between the two countries and unanimously agreed to further study and enhance cooperation in agricultural fields, and agreed as well that each year both sides would recommend projects for scientific and technical cooperation, would each provide information to each other at scientific and technical conferences held by organizations in the two countries, and that each would exchange information on new technologies, as well as catalogs of licenses and exclusive technologies.

12. The 24th session of the committee for Chinese-Hungarian scientific and technical cooperation

The agreement between China and Hungary for scientific and technical cooperation was signed in Beijing in October 1953. From this time until 1985, the committee for Chinese-Hungarian scientific and technical cooperation met 23 times, and both sides carried out 560 agreed upon projects.

The 24th session of the committee for Chinese-Hungarian scientific and technical cooperation was held in Budapest 9-14 September 1985. There were 29 new scientific and technical cooperative projects agreed upon at the meeting and 28 single observation projects, which was a 60 percent increase in projects over the previous session. The range of cooperation includes the fields of agriculture, coal mining, machinery, light industry, electronics, and medicine and hygiene. Analyzing this from the point of view of the projects newly determined, the methods for bipartisan scientific and technical cooperation and the forms of said cooperation are constantly intensifying, as shown by: 1) this was the first time both parties signed a joint research project for technology to control water in coal mines; and 2) there were more cooperative projects between department counterparts in both countries, being 58 percent of the newly agreed upon projects.

13. The 18th session of the committee for Chinese-Polish scientific and technical cooperation

The 18th meeting of the committee for Chinese-Polish scientific and technical cooperation was held 7-14 October 1985 in Warsaw. Both parties reached agreement on 63 new exchange projects and three joint research projects, which when included among the 11 science and technology observation projects remaining from the previous session, makes more than 87 projects, the execution of which this session had to arrange. Specialties included electronics, machinery, industrial chemicals, light industry, coal mining, railways, agriculture and forestry, medicine, ship building, transportation, food products, and mapping. In addition, both sides are also exchanging detailed lists of recommended projects with a group of scientific and technical achievements the rights to which could be transferred.

14. The first meeting of the mixed committee for Chinese-Austrian scientific and technical cooperation

Based on the agreement for scientific and technical cooperation between China and Austria, the first session of the mixed committee for Chinese-Austrian scientific and technical cooperation met 21-24 October 1985 in Vienna.

Ten cooperative projects were agreed upon at the session for execution from 1986 through 1988, the substance of which include the areas of nonferrous metals processing, wave propagation, mapping, measurements, tunnel construction and mathematic simulation, and medicine. Particular working programs for the cooperative projects were also agreed to at the meeting, and included the forms of cooperation, exchange of personnel, and expense provisions.

15. The fifth meeting of the joint committee for Chinese-West German scientific and technical cooperation

In accordance with provisions of the agreement for scientific and technical cooperation between the governments of China and West Germany, the fifth session of the joint committee for Chinese-West German scientific and technical cooperation was held in Bonn 4-15 November 1985.

At the conference, both parties reviewed the situation regarding progress of scientific and technical cooperation since the previous session. They discussed plans for scientific and technical cooperation in 1986 and signed a summary of the meeting. After negotiations, both parties determined 25 fields for cooperation. Aside from continued execution of projects, the projects for cooperation that they newly determined or will discuss further include: urban gasification, dense coal tar technology, oil extraction, nuclear heating stacks, computer-aided engineering, clothing design, civil aviation, earth remote sensing, Shanghai environmental protection and remote heating, methyl alcohol fuel experiments, scientific and technical statistics, and legislation.

16. The regular meeting for 1985 Chinese-Yugoslav scientific and technical cooperation

In accordance with the provisions of the agreement regarding Chinese and Yugoslav scientific and technical cooperation, the two countries met in their regular meeting for scientific and technical cooperation in Beijing 8-15 November 1985.

After bipartisan negotiations, 53 cooperative projects were determined. Among them, nine are observation projects undertaken by the Chinese and three are for the provision of materials; there are 12 observation projects undertaken by the Yugoslavs and two are for the provision of materials; 27 projects were suggested for cooperation between unit counterparts within departments. Included specialties primarily involve construction, metallurgy, agriculture and foodstuffs, industry, forestry, machine manufacturing, chemistry and biology, nuclear energy, water conservancy, light industry, and computer technology. At the meeting both sides reached agreements regarding problems with the reciprocal exchange of scientific and technical observation delegations (groups).

17. The third session of the mixed committee for Chinese-French scientific and technical cooperation

The third session of the mixed committee for Chinese-French scientific and technical cooperation was held 19-21 November 1985 in Paris.

After negotiations, both sides determined 74 cooperative projects for 1986-87, they decided to maintain the scale of cooperation determined at the previous meeting, the enhancement of major fields, such as cooperation in the fields of biotechnology, electronic technology, and new materials, and they agreed upon 12 cooperative projects in biotechnology.

18. The 27th meeting of the joint committee for Chinese-Czech scientific and technical cooperation

The 27th meeting of the joint committee for Chinese-Czech governmental scientific and technical cooperation was held in Beijing 7-10 December 1985.

After discussions and consultations, both parties determined 34 cooperative projects, each to be responsible for 17, an increase of 55 percent over the previous year. The projects involve the sectors of railways, machinery, electronics, metallurgy, industrial chemicals, coal mining, hydroelectricity, mining, textiles, light industry, and hygiene.

During the meeting, the governments of both countries signed an outline for scientific and technical cooperation from 1986 through 1990. They then reached a consensus agreement regarding long-term cooperation in developing 42 specialties in the 10 fields of metallurgy, the machinery manufacturing industry, the electromechanical industry, the electronics industry, light industry, chemistry, fuels, power, agriculture, medicine, building, and nuclear power projects.

There were also the following activities in 1985 regarding bilateral scientific and technical cooperation:

1. September 1985, the governments of China and Spain signed an agreement in Beijing for scientific and technical cooperation. With this, the former 50 agreements for scientific and technical cooperation with foreign governments, or for economic, industrial, and scientific and technical cooperation, was increased to 51.

2. During 24 April-4 May 1985, at the invitation of the Canadian minister [of state] for science and technology, a Chinese scientific and technical delegation visited Canada. During the period of the visit, the Chinese delegation held talks with departments of the Canadian Ministry for Science and Technology, the International Research and Development Center (IDRC [sic]), the Office of International Development, and the State Research Council, whereupon they reached agreement upon signing a memorandum of understanding regarding scientific and technical understanding between the Chinese State Science and Technology Commission and the Canadian Ministry for Science and Technology. Both parties agreed through consultations that that memorandum would be signed when the Canadian minister of state for science and technology visits China, and that its contents would be: 1) encouragement and promotion of contacts between officials of both sides, and cooperation to be carried out in areas of shared interest on a basis of equality and mutual benefit; 2) promotion and formulation of science and technology policies and planning, as well as engagement in related activities.

3. During 9-18 June 1985, the Chinese State Science and Technology Commission carried on bureau level discussions with the Soviet State Science and Technology Commission. These were the first working conversations between the two science and technology commissions since the December 1984 resigning by China and the Soviet Union of a scientific and technical agreement. Through

discussions, both parties reached agreements and exchanged notes regarding planning for Chinese-Soviet scientific and technical cooperation. Both parties agreed that from the latter half of August 1985 through the first quarter of 1986, each will send 11 scientific and technical delegations or groups for specialized observation. The 11 projects undertaken by the Soviet Union will involve the areas of the electric power industry, capital construction, agricultural crop products and resources, apatite mining, petroleum processing, nonferrous metals, salmon cultivation, geology, cotton spinning, toughened glass, and isomer rubber. The 11 projects to be undertaken by the Chinese side involve the areas of water conservancy and the generation of electricity, soil improvement, paddy rice breeding, railway shipping, agricultural science and technology, nonferrous metals, hydrometeorology, cotton spinning, plant and chemical drugs, chemical reagents, and tumor studies. These projects have been affirmed by means of a mutual exchange of notes.

4. In July 1985, unanimous consent was reached by New Zealand's Ministry of Science and Industry and the State Science and Technology Commission as they signed a conference summary, having determined that within 3 years the New Zealand Ministry of Science and Industry will accept annually 36 Chinese scientists to work in research organizations of that ministry.

In addition, in 1985 civilian scientific and technical exchanges between our country and several other countries were quite frequent, and aside from continuing deeper and more effective cooperation and exchanges with civilian scientific and technical organizations, there were also new developments in a channel for cooperation and exchanges that has come into being in recent years--exchanges with organizations of retired science and technology specialists. In 1985, we invited more than 50 foreign retired specialists from different specialties to come to China to undertake technical guidance and exchanges. These retired specialists have played roles in the aspects of the technological transformation of old factories in China, the trial manufacture of new products, and in advancing enterprise management, and have been welcomed by the areas in question.

IV. The Prospects for Strengthening International Cooperation

As the restructuring and opening to the outside continue to progress in this country, we must also continue to restructure the management of international scientific and technical cooperation and exchanges, and the enhancement of overall management. To this end, we should revise and establish necessary regulations and methods that are beneficial to a further opening up, should establish and perfect the statistical system and methods, should pay special attention to the implementation and applications of achievements from foreign scientific and technical cooperation and exchanges, and should overcome formalism, and should emphasize practical results.

We should continue to enhance bilateral scientific and technical cooperation and exchanges with all countries, should encourage departments and units from all sectors and regions to establish cooperative and exchange relations with their counterparts in corresponding foreign departments and units. We should

broadly develop scientific and technical cooperation and exchanges with other countries in the world in industries like agriculture, energy resources, transportation, steel, industrial chemicals, machinery, electronics, environmental protection, textiles, and foodstuffs, in the new technology fields such as microelectronics, biotechnology, fiber optic communications, new materials, and software, and to improve the levels of our scholarship and technology regarding small to medium enterprises, town and township enterprises, and rural construction. We should continue to strengthen multilateral scientific and technical cooperation and exchanges, and strive to hold more international science and technology conferences in this country in 1986, which will aid this country in having even more scientists and technicians participating in international science and technology activities. We should continue to improve the conditions under which we develop international scientific and technical cooperation and exchanges to create the necessary material and environmental conditions by which this country can further expand scientific and technical exchanges with all countries in the world.

12586/6091
CSO: 4008/7

CHAPTER 2. THE SCIENTIFIC AND TECHNOLOGICAL CONTINGENT

[Text] In the 36 years since the founding of China, we have formed a scientific and technical contingent that has a certain degree of attainment and is of a considerable scale. According to statistics from the end of 1985, there are a total of 7.8167 million natural scientists and technicians throughout the country. Among these, 3.4041 million are engineering technicians, 450,700 are agricultural technicians, 336,400 are scientific researchers, 2.161 million are hygiene technicians, and 1.4645 million are mathematicians.

I. The Development of the Scientific and Technical Contingent

Before liberation, only 180,000 of our people had graduated from higher level schools, there were only about 50,000 scientists and technicians, 40 science research organizations, and only a few hundred people exclusively engaged in science research. After liberation, when the first 5-year plan had begun, there were 450,000 natural science and technical personnel in China. Before the "Cultural Revolution," there were 2.458 million natural scientists and technicians throughout the country (not including national defense and those scientists and technicians not employed in their fields or who were idle). From 1978 through 1984, average annual growth for natural science scientists and technicians was 9.4 percent. This rate of growth was 6.5 percent higher than for staff at the same time. Even though this was true, the proportion of scientists and technicians among each 10,000 social laborers lags far behind that of developed countries, and our reserve strengths are insufficient. Based on a 1977 report on statistical annual materials by the United Nations text documents organization, among 141 countries, within an average 10,000 population group there would be 9 people in a higher institution in China, which was ranked 113th. This situation in which there is a serious lack of scientists and technicians constitutes a serious obstacle in the drive toward modernization, and we must hasten the development of education and allow our scientific and technical contingent to rapidly mature and strengthen.

II. The Distribution of the Science and Technology Contingent

The scientific and technical contingent in this country matured during the process of national economic construction when particular emphasis was laid upon developing industry and especially heavy industry. To establish the

systems of heavy industry and the national defense industries in this country, it was necessary to give precedence to the concentration of a strong scientific and technical capability within a certain period of time, and to ensure that. However, due to factors within the system and to limitations in specialized equipment, the distribution of the scientific and technical contingent could not be shifted and adjusted in a timely manner in accordance with the foci of national economic developments. This meant that the distribution of a science and technology capacity could not be adapted to the needs of developments in the national economy. Similarly, because of factors in the system, scientists and technicians in this country tended to be concentrated in higher institutions and in research units, while the scientific and technical capacities of enterprises were quite weak. According to statistics, technical personnel in each specialty in the first line of industrial and agricultural production have not accounted for one-half of those so employed. And we are seriously lacking scientific and technical personnel in the industries we are currently emphasizing during our current economic construction, namely, energy resources, transportation, communications, and materials, with greater discrepancies than with the number of scientists and technicians in other heavy industrial sectors.

In recent years, there have been changes in agricultural structures in this country, and town and township enterprises have sprung up, but the technical capacity of town and township enterprises in this country is deficient. Among an average group of 10,000 people engaged in this work, only 9 will be scientists or technicians, not even 0.1 percent. This has become a great obstacle in the development of town and township enterprises in this country.

Due to historical reasons, the regional distribution of scientists and technicians is not very rational. In the frontier regions that occupy two-thirds of our total area, the scientists and technicians that are dealing with developing the economic superiorities there are only 13 percent of the scientists and technicians in these regions. This urgently needs attention.

III. The Situation Regarding Ages of Scientists and Technicians

Based on statistics before evaluation work of technical and professional posts was temporarily halted 1 September 1983, among 87,000 high level specialists in the natural sciences, more than half were over 55 years of age. About 30 percent were 61 or older. In 1955 there were 172 committee members in the Chinese Academy of Sciences, with an average age at the time of 48. At the time of readjustment in 1981 there were 190, with an average age of 73. After the 1981 readjustment there were 400, with an average age of 70, 91 percent of whom were 60 or older. After the restructuring of the technical and professional post evaluation system and implementation of a specialist technical post hiring system, this kind of situation will change greatly.

In addition, among scientists and technicians, 1.91 million are from 31 to 40 years of age, while 2.53 million are from 41 to 50. Because of this, we should broadly open the paths to study, and use various ways to vigorously train our personnel, so when we are seeking those who are most needed in our

drive toward socialist modernization, there will be a large group of young and middle-aged scientists and technicians to take their places among our contingent.

IV. The Situation Regarding Formal Schooling and Position Titles Within the Science and Technology Contingent

There is an outstanding group of talent within the science and technology contingent in this country, and their level of science and technology is in the front ranks in the world. But looking at it overall, due to deficiencies in fundamentals and limitations in capabilities, the level of formal schooling for scientists and technicians in this country is still rather low. According to 1984 statistics, a breakdown of formal schooling for the natural science and technology contingent in this country shows that 44.9 percent have graduated from a higher institution and 41.1 percent have graduated from middle level vocational schools. The proportion of graduate students is even less, but the rate of growth in recent years has been very quick, and the annual average number of students admitted has grown at a rate of 16 percent (colleges are 8 percent).

Breaking down the situation according to original position titles, among natural science and technology personnel in this country, more than 5.05 million have technical or professional posts, which is 67.6 percent of the total number of the natural science and technology contingent. There will be great changes in this situation in the near future.

12586/6091
CSO: 4008/7

CHAPTER 3. INFRASTRUCTURE

[Text] The many major achievements in the modern natural sciences were obtained only through drawing support from new methods in the laboratory. Famous laboratories throughout the world having advanced laboratory equipment and technology have bred many Nobel prize winners and famous scientists. The means for science research have directly affected the qualities and pace of achievements. Developed countries all tend to emphasize efforts in this area. To effectively develop activities in science and technology, we must make the most of and develop the fundamentals and conditions for science and technology.

Fundamentals and conditions for science and technology primarily include manpower, materials, finances, information, and time. In particular, aside from scientific and technical talent, these also include the management, development, and building of laboratories, scientific and technical expenses, science instrumentation, goods and materials, equipment, reports, publications, chemical reagents, and laboratory animals. They may even include the sale and export of science research trial production commodities and technologies. Science and technology are continuing to develop, for which reason we must continue to provide and renew the conditions and means under and by which it proceeds.

The management of science and technology fundamentals and conditions is one of the most important aspects of science and technology management. It is critical to the technical science that is between technology and the economy, and is also critical to the economic science between the economy and technology. It requires that people who are engaged in work of this sort actively, reasonably, effectively, and economically provide the conditions by which to ensure the completion of the science and technology mission. Therefore, management personnel engaged in efforts at conditions for science and technology must not only understand science and technology, but must also understand economics and management science. They should study the rules and characteristics for research conditioning efforts; they should take charge of planning and directions for scientific and technical development; they should formulate the principles, policies, systems, and laws and regulations for conditioning efforts, and should also organize and train talent in various specialties to make the most of the capabilities of instrumentation and equipment and to improve the results therefrom. In summary, we must make our limited manpower, funding, and material conditions produce the greatest usefulness.

I. The Development of Conditions for Science and Technology in This Country and Their Current Status

The rapid development of scientific and technical efforts depends upon the creation of advanced technical conditions, for which reason party and state leaders are completely cognizant of scientific and technical conditioning efforts.

Long ago, in 1957, the State Council approved the establishment of four small groups under the committee for science planning: for libraries, materials, instrumentation, and chemical reagents. They set up a national and regional library network, enhanced the management and exchange of scientific and technical information and records materials, they have resolved the provision, production, and importation of instrumentation needed by science research, and have made great efforts in the areas of research into, production of, provision of, and importation of chemical reagents, all of which has played an important role in promoting the development of science and technology, and has as well laid a material foundation for the development of scientific and technical conditions.

Since 1977, Comrade Deng Xiaoping has made clear on several occasions the importance of management efforts in science and technology, and has also indicated that it is to perform well as the "minister of reserves" for science research. Premier Zhao Ziyang is extremely concerned about science and technology, and has pointed out the expenses that are necessary, the necessary science research conditions, and the necessary implementation. Under their direct concern, the situation regarding fundamentals and conditions has made great advances.

Efforts in scientific and technical fundamentals and conditions in this country may largely be summarized as follows:

1. Science and Technology Outlays

Since the founding of our country, there have been great developments in our science and technology. Funds for science research as well as the proportion they represent of China's national financial outlay have increased annually (see Table 1). The nation has determined that within a certain time in the future, allocation of funds for science and technology through central government and local finances would be gradually increasing until their rate of growth exceeds the normal revenue of public finance. Banks have already developed credit services for science and technology and will also be progressively expanding that service. The continued increase in science and technology outlays is one of the important guarantees for developing science and technology.

2. Science and Technology Talent

Training and employing a huge contingent of science and technology talent is the most important assurance for the development of science and technology.

Table 1

Unit: 100 million yuan

Year	National science research expenses	GVIAO	National expenditures	% of science research expen.: Industrial & agricultural output value	% of science research expen.: Fiscal expenditure	S&T 3 item expen. of nat. expen.	Science research capital	Science operating expenses outlays
1977	41.48	4978	843.53	0.83	4.92			
1978	52.89	5634	1110.95	0.94	4.77			
1979	62.29	6379	1273.11	0.98	4.89			
1980	64.59	7077	1212.73	0.91	5.33			
1981	61.58	7580	1114.97	0.81	5.52	24.57	9.34	27.67
1982	65.29	8291	1153.31	0.79	5.66	25.70	8.50	31.09
1983	79.03	9211	1295.45	0.86	6.11	34.70	10.00	34.33
1984	95.01	10797	1546.40	0.88	6.14			
Totals								
1st FYP	14.37	5612	1369.86	0.26	1.05			
2d FYP	97.42	8848	2277.67	1.10	4.28			
1963-65	70.05	5754	1204.98	1.22	5.81			
3d FYP	109.32	12804	2518.52	0.85	4.34			
4th FYP	183.33	19563	3919.44	0.94	4.68			
5th FYP	260.50	28604	5246.52	0.91	4.97			
1979-83	332.78	38536	6046.57	0.86	5.50			

Note: Money value averages listed are in prices from that year.

"1st 5-year plan": the first 5-year plan in our development of the national economy (as below), 1953-57;
"2d 5-year plan": 1958-62; "3d 5-year plan": 1966-70; "4th 5-year plan": 1971-75;
"5th 5-year plan": 1976-80.

At present, we have already constituted in this country a scientific and technical contingent that has distinct achievements and is of a substantial scale. According to statistics from the end of 1985, there are 7.8167 million natural science and technology personnel in this country. Those among them who have graduated from higher institutions are 44.9 percent and 41.1 percent have graduated from middle-level vocational schools.

3. Large Laboratories

In order to achieve a major improvement in the conditions for experiments in science research, beginning in 1984 we selected major disciplines and fields, and in a planned way gave preference to building a group of major laboratories with more advanced equipment. During the period of the "Sixth Five-Year Plan," we had already established 20 major laboratories at colleges and universities and research organizations, and during the period of the "Seventh Five-Year Plan" will build yet another group.

4. Fundamentals Service Center

Beginning in 1982, the state has set up in a planned and gradual way a group of information centers, analysis and testing centers, measurement centers, computer centers, and applied math consulting and service centers at the provincial, municipal, and autonomous region levels, all for public use and to serve the development of science research and the national economy. Over the past few years, the state has subsidized capital construction funding for the building of three local centers to an extent of more than 70,000 yuan, and approved establishment of eight state centers. At present, science and technology commissions in all areas own 25 computing centers, 18 testing centers, and 24 information centers that have been basically completed or are currently in the process of construction. All ministries and commissions of the State Council have also independently established offices of information and computing stations, and some industries have also built industrial testing centers in accordance with their needs. These centers are to serve all of society.

5. Libraries and Publication and Distribution

In 1963, we established the Chinese Foreign Language Bookstore, whose name was later changed to China Books Import and Export, Inc. There are at present 92 scientific and technical publishing interests throughout the country, among which 53 are in the Specialist Science and Technology Publishing House of the central system, 28 are local science and technology publishers, and there are 11 university publishers. In all, 2,641 scientific and technical journals are published, among which the central system publishes 1,038 (411 of which are distributed domestically, 627 are distributed both domestically and abroad), and 1,423 natural science and technology publications are done locally. A book provision and distribution network has been established throughout the country and within all provinces, cities, and autonomous regions, which has provided a great deal of material and information for science and technology research.

6. Equipment and Goods and Material Provision

In 1961, we founded the China Scientific Equipment Company, the primary task for which was, in accordance with the characteristics of science research, to resolve the insufficiencies in the provision of goods and materials to science and technology research organizations and concerning goods and materials that were difficult to include within planning, but which was not to take up provision of same to markets. All provinces, municipalities, and autonomous regions have also been establishing science equipment companies.

In 1978 the state stipulated that goods and materials needed by science and technology would be listed separately in national goods and materials planning and would partake of national allocation of goods and materials to ensure the provision of goods and materials for science research.

These measures have guaranteed the smooth progress of the solution of major scientific and technical problem solving projects and projects concerning the building of national major laboratories.

7. Instruments and Equipment

In 1963, the State Council approved the establishment of a nationwide instrument management group, which was responsible for unified leadership of instrument management for the entire country.

In 1978, the state stipulated that the importation of 23 kinds of large precision instruments would require approval from the State Science and Technology Commission, and that allocation of quotas for the use of exchange in importing would be controlled by the State Science and Technology Commission.

To strengthen the developmental capacity of science research units, since the founding of the PRC, this country has imported and self-manufactured nearly 10,000 large precision instruments. The state has also allocated particular item funding to support the development of large-scale precision instruments. In recent years, the State Science and Technology Commission has arranged for the development of two series of chromatographs and supercentrifuges. It has also allowed the latter to be integrated with import projects, on 25 September 1985 officially checking and accepting the first batch of products using scanning electron microscopes and organic spectrometers manufactured with imported technology. After absorbing and assimilating the technology of the imported Amray 1000B scanning electron microscope, some of those components have now been nationalized. The scanning electron microsope lens tube manufactured in this country is not only used in the imported products, but is also exported to the United States.

8. Laboratory Animals

In 1981, the State Science and Technology Commission began to arrange for the regulation and coordination of laboratory animal science and technology, and in 1985 set up the China Laboratory Animal Development Center to enhance management of work with laboratory animals.

The science of laboratory animals is a rising new fundamental comprehensive scientific discipline. Over the past several years, the planning and construction of national, profession-specific, and regional laboratory animal centers have been formulated and implemented in an organized and planned fashion. Training for laboratory animal scientific and technical personnel is currently being done in various ways, and international scientific and technical channels have progressively been opened for international cooperation.

In order to strengthen management of science and technology fundamentals and conditions, the State Science and Technology Commission convened in 1983 the first working conference on accommodating science and technology. The primary discussion topic was how to bring a new aspect to the work of accommodation under these new circumstances to promote the development of accommodation in every province, municipality, and autonomous region throughout the country. Currently, science and technology commissions in 29 provinces, municipalities, and autonomous regions, as well as the majority of ministries and commissions of the State Council have established departments for managing science and technology accommodation to manage science and technology accommodation for particular regions and departments. Each region and department has continued to make full use of and even improve the contingent for accommodating science and technology. Of operations and maintenance personnel for large-scale precision instruments alone, there are more than 30,000 people throughout the country. Personnel at the three types of centers--computing, testing, and information, are approximately 6,600, some 70 percent of whom are scientists or technicians.

II. The Prospect for Accommodating Science and Technology

1. Changing the Allocation System

When faced with different kinds of science research, make use of different methods of allocation. This is one of the primary tenets for the restructuring of the science and technology system. Beginning in 1986, science operating expenses for each ministry and commission of the State Council will be managed by the State Science and Technology Commission. We want to categorically manage expenses in the face of the characteristics of different kinds of scientific and technical activities. From now on, the state will gradually reduce and even eliminate gratuitous allocation of funds to developmental research and to research from which a use value could be expected near term. These units will have to obtain their operating expenses through signing contracts with enterprises and through the channels of transferring the rights to technology to enterprises or of providing services to society. For basic research and for applied research for which a use value cannot be obtained in near term, there will be a fund system that will make use of the methods of evaluation from similar professions and of preferential support. Although for research units engaged in the socially beneficial activities of medicine and hygiene, labor protection, family planning, disaster prevention, and environmental sciences, units engaged in technology fundamentals such as information, standards, measurements, and observation, and units of agricultural science research the state will allocate funding, they must implement total responsibility systems. For rising new technology

developments that are rapidly replaced or for which the risk is greater, the method of risk funding will be used. There will be bidding and contracts for major national science research projects. These changes demand that on the basis of numerous and penetrating survey studies we formulate a series of regulations and laws to ensure the smooth progress of the restructuring.

2. Make Full Use of Technical Potential, Promote the Socialization of Science and Technology Accommodation

The work of accommodating science and technology is not only to serve units of science and technology, but is also to serve economic units, capital construction units, and to serve industrial and mining enterprises and the broad countryside. On the basis of survey research, we want to study and formulate particular principles, policies, and methods that will promote the socialization of science and technology accommodation. We want to energetically open up channels of provision for science and technology accommodation and to mobilize and organize the strengths of goods and material departments at all levels and of all aspects of society to provide accommodation for science and technology; under the prerequisite of guaranteeing the needs of the host department or the host unit, we want to arouse science and technology accommodation units to open up their science and technology accommodation to the outside, making full use of its usefulness to the utmost degree; and we want to arouse operational units serving science and technology to continue to expand their operations, and especially science equipment companies at all levels should strive to develop their activities in development instrument repair, laboratory engineering contracts, and hiring out their services.

3. Closely Integrate With Science and Technology Developmental Planning, and Do a Good Job of Developing Science and Technology Accommodation

At present, we want to integrate closely with "Seventh Five-Year" planning and with major problem solving projects in the "Seventh Five-Year Plan" to serve the technological transformation of traditional enterprises, the formation of rising new industries, the invigoration of local economies, and that directional applied research and basic research that will have a long-range influence on development of the national economy.

To do scientific and technical service work well, we must establish a group of modern experimental facilities and experiment bases. At present, we should pay special attention to making the most of the potential of existing conditions and facilities and to making full use of and transforming existing laboratories in important positions, allowing them to modernize as quickly as possible. In this country, technology systems have not been completely established. It is thus difficult to consider planning as a whole for construction and transformation and difficult to improve the use rates of instruments and equipment, which consequently affects the improvement of the enthusiasm and technical levels of technical personnel. To this end, we should establish and perfect a technology system as quickly as possible to seek a situation in which the accommodation of science and technology can suit the entire development of science and technology.

4. The building of science and technology accommodation should be coordinated with the economic construction of a particular region or department and with the developments of science and technology. It should earnestly seek to form its own characteristics based on the needs of the development of the economy of a particular region or sector and of science and technology. It should foremost make full use of the existing conditions of the science and technology units, higher institutions, and large-scale enterprises in a particular region to coordinate division of labor and rational planning and to form integrated organizations of various forms. Necessary allocation of technical personnel should also be suitably arranged.

5. The quality of cadre and contingents engaged in accommodation work directly affects the level of this work. At present, science and technology accommodation departments in all sectors and regions should pay attention to strengthening key membership, to supplementing new production capabilities, and to training existing personnel. They should strengthen leadership to allow the knowledge structures and ages of the whole science and technology accommodation cadre contingent to change along reasonable lines. This is an important guarantee by which the efforts at science and technology accommodation can smoothly develop. From now on, we should enhance the cultivation of management personnel for accommodation work.

12586/6091
CSO: 4008/7

CHAPTER 4. INFORMATION SYSTEM

[Text] I. The Development of the Science and Technology Information Undertaking

The science and technology information effort is an important condition for the development of the science and technology enterprise and by which to promote modernization. In 1956, China established a national science and technology information center--the China Institute of Science and Technology Information. As things have turned out, the science and technology information undertaking in this country has developed very rapidly. The ministries and commissions of the State Council have set up 33 information institutes and the provinces, autonomous regions and cities have established 35 information institutes, which together with more than 3,000 information stations set up by base level units form China's science and technology information network. Nationwide, there are some 60,000 information specialists, which when added to those who are information workers with other responsibilities, totals more than 100,000 people.

In July 1980, China convened the 5th National Science and Technology Information Working Conference, at which was proposed the principle that "science and technology information efforts must effectively serve the building of the national economy." Guided by this principle, the numerous science and technology information workers throughout the country have not only provided large amounts of information to scientific and technical research, but have also paid attention to actively serving economic construction, achieving outstanding results in the last few years. These have been apparent in:

1. Regarding strategic decisions, after systematic accumulation and analytical study of large quantities of domestic and foreign documents and data, many of the ministry and commission, provincial and city information institutes have proposed many scientific recommendations in keeping with our national situation, and have served as advisers in guiding policy-making.

2. Regarding key science and technology projects, whether major national projects or projects involving local science research or production technology, the information sector has provided huge amounts of materials and data, which have been greatly helpful to the completion of projects. The first period of construction of Gezhouba that has been the focus of world attention has now been successfully completed, and the information sector has kept pace

throughout. At critical times in the project, the "Foreign Reference Materials on Energy Reduction and Thrust Prevention" played an important role in solving the problems of energy reduction and thrust prevention on soft-based dam construction in the lower reaches of the river.

3. Regarding the drawing up of regulations and plans, the information sector has provided large quantities of reference materials and background materials. When the ministries and commissions of the State Council and the various provinces, autonomous regions, and municipalities are drawing up programs for national economic development and plans for science and technology development, or even when industries or large enterprises are formulating programs and plans, information departments have provided systematic and reliable reference materials. For example, the national bicycle industry information network promptly provided the State Planning Commission and the Ministry of Light Industry with comprehensive technical and economic comparative data. This data showed that the staff of the Shanghai bicycle industry was 7 percent of the total staff in the bicycle industry nationwide, that their equipment was 12 percent of that nationwide, but that their production quantities were 29 percent, and the profits were 45 percent. There are major principles of development that must be adopted, and measures that should be implemented for those factories that have had losses for long periods and that have inferior products, measures that involve closure, cessation of production, and the changing of items produced. Later, this information network again brought up "Some Views on Developing the Bicycle Industry in This Country," which stressed a desire to strengthen unified leadership, enhance unity, and disliked blind establishment of locations. This material played an important role in the formulation of the policy by the State Council that "no area should blindly establish locations and change its production to that of bicycles."

4. Regarding technology importation, the information sector has played the role of "pathfinders," consequently allowing pertinent departments to avoid circuitous routes in correctly selecting and importing foreign technology or technical equipment, which has quickened the pace of economic construction in this country. For example, the Daqing and Shengli petroleum chemical plants were prepared to import butyl alcohol and octyl alcohol production assemblies, but not understanding conditions regarding foreign technology, for a time were unable to come up with an import program. To this end, the information department promptly gathered and studied foreign scientific and technical materials, whereupon they provided materials on the situation regarding foreign butyl alcohol and octyl alcohol production technology. This explained the advantages and disadvantages of many different technologies, undertook a technical and economic analysis, and emphatically recommended a new foreign technology concerned with low pressure carbonyl synthesis. Finally, after study by pertinent departments, it was decided to import the low pressure carbonyl synthesis technology, and misdirection was avoided.

5. Regarding the forms and methods of service, there have also been new developments in recent years. With the development of the restructuring of the economic system, the information sector at all levels has not paused at

the service mode of the past where they waited for the information customer to "knock at the door," but have shifted to develop in the direction of initiated service and an invigoration of channels of information exchange. Some information departments are providing economic information and market information at the same time as they provide technical information; on the basis of their document materials service, some information departments have provided recommendations or plans for manufacturing technology development; some information departments have entered the technology marketplace to provide information and advice to both parties buying and selling technical achievements; and some information departments have initiated the organization of technical information trade fairs. The development of service forms and methods in the information sector has enhanced relations between the information sector and information customers, which benefits the development of economic construction.

There have also been new developments regarding service to agricultural production. With the implementation of each item in the party's rural policies, there have been unprecedented new trends in countless villages. To suit this new situation, information departments at the prefectural, city, and provincial levels throughout the country have gone to villages, to the grass-roots level, and to the farmers to serve, and have achieved flexibility of all sorts regarding forms and methods. Generally speaking, this has been to earnestly send information to everyone. To suit the tradition of "going to market," some provincial information departments have held "science and technology country fairs" at which they sell scientific and technical materials; some provincial information departments have arranged for "large covered trucks" to take science and technology materials "into the townships and through the villages," coming into direct contact with farmers and receiving warm welcomes. Some specialized households have responded by saying that in the past they would go to great lengths to gain new experience, but now by sitting at home they can obtain new information. Some provincial information departments have developed farmer information personnel throughout the province, and when there is word of new information, it is first transmitted to the information personnel for transfer by the information personnel to the farmers. In summary, the information sector in prefectures, cities, and provinces throughout this country is making great strides to invigorate the rural economy.

II. Building a Science and Technology Information System

In building the science and technology information system in this country, we should absorb and take as examples all advanced methods that reflect the rules of modern socialized production from all countries of the world, including developed nations, and then we should forge our own path of development. From a macroscopic point of view we should concentrate on strengthening policy guidance, while microscopically, we should loosen up and invigorate so as to suit the needs of socialist modernization in this country.

The State Science and Technology Commission has already set up an Office of Science and Technology Information, whose chief responsibilities include:

First, formulating policy: For example, information cadre policies, including position evaluations, promotions, and examinations of information cadres, and the training policies of information cadres; policies regarding information funds, including the percentage information operating expenses are of science and technology funds, and the policies regarding applications for science and technology funding.

Second, formulate programs and plans: For example, a program for building a national system for retrieving science and technology documents publications, a program for building a national computer on-line retrieval system, and plans for setting up the national distribution of science and technology documents and materials.

Third, coordination of organizations.

Fourth, vocational guidance.

The China Institute of Science and Technology Information is currently forming science and technology document centers, retrieval centers, and information study centers that are nationally comprehensive. Each office of information in each ministry, commission, and bureau should form scientific and technical document centers, retrieval centers, and information study centers for each specialty. Based on particular major provincial or city offices of science and technology, we should establish comprehensive science and technology document centers, retrieval centers, and information research centers in certain localities. In accordance with the principle of relaxing and invigorating, even the many grass-roots level science and technology information organizations can proceed from the relationship between information supply and demand to determine the respective structural setups, nature of work, and working methods without demanding unanimity. All information organizations of this type, aside from accomplishing the prescriptive planning tasks from higher up, can all face society and improve the quality of service and work efficiency, and can "link up" with information customers to link supply and demand, making a contribution to economic construction.

In recent years, the self-establishment of the science and technology information undertaking in this country has made great advances, which is primarily shown in the following three areas.

1. Regarding the adjustment of leading groups, a large group of intellectuals who are in the prime of their lives, are well-educated and are highly capable in their professions have been promoted to positions of leadership. According to statistics involving 202 institute directors and deputy directors of 88 information institutes who were in the first level in the ministries and commissions or at the provincial first levels, their average age was 49; and 181, or 89.6 percent, had a college or university education.

2. Regarding the building of contingents, the information offices of all ministries and commissions, all provinces, cities, and autonomous regions, and even the grass-roots level information networks (stations) all treat the training of on-the-job information personnel in their particular department,

region, or system as an intellectual investment of strategic significance. Every area and sector has held various kinds of training classes, study conferences, and lectures on particular subjects, which have highlighted functionality and effectiveness, and have had an outstanding role in raising the professional level of cadres who are on the job.

The proper path for the college-educated information cadre has been quite smooth in recent years. According to incomplete statistics, 25 higher-level institutions throughout the country have set up library information departments or specialties, or have added information classes, documents classes, or retrieval classes. The science and technology information personnel training center commissioned by the State Science and Technology Commission to be arranged by Wuhan University has been established and began admitting students in the fall of 1984. This has created the conditions in China for the proper training of a specialist information cadre.

3. Regarding the rewarding of information achievements, progress here, too, has been rapid in recent years. It has been universally recognized at all levels of leading organizations that information achievements are the crystallization of intellect and hard work on the part of information workers, and that they are a potential production force in an intellectual state. Through various means, they are transmitted to all aspects of society to be used by science research and production. They can be "materialized" in the form of production forces and can create wealth to promote the development of the economy and of society. For this reason, some 21 ministries and commissions, such as coal mining, petroleum, and the chemical industry, and 5 provincial and city information offices in Sichuan and Tianjin have drawn up their own ways to reward information achievements, and with the approval of higher-level leading organizations have begun work to evaluate science and technology information achievements for the purposes of reward. In 1985, science and technology information achievements were part of the award evaluation activities of the national awards for scientific and technical advances, and with the approval of the national evaluation committee, among the 1,772 national level prizes for technical advances, 13 were for prizes for science and technology information achievements, one for a first prize, two for seconds, and 10 for thirds. This is the first time information achievements have been included among national-level awards. This has served to greatly motivate the enthusiasm of many information personnel.

III. Building a System for the Retrieval of Publications From Science and Technology Documents

Retrieval publications are an important means for reporting on and searching science and technology documents, they are tools necessary for the normal services of science and technology information departments, and at the same time are a prerequisite for implementing the automated retrieval of science and technology documents. Therefore, science and technology information sectors in major developed countries of the world cannot help but include the editing and publishing of retrieval publications as one of their fundamental duties.

Ever since the establishment of the China Institute for Science and Technology Information in 1956, which began translation of the Soviet ABSTRACT JOURNAL, it has deliberately added to the quantities of document abstracts it has collected. To strengthen the organization and coordination of this work, in 1961 we formed the "committee for the editing and translation of Chinese and foreign science and technology documents" (the name being changed in 1978 to the "committee for the editing, translation, and publication of Chinese science and technology information"). At present, China has 219 retrieval publications. There are 1.2 million annual reports (among which 1 million are for Chinese and foreign science and technology documents and 200,000 are for domestic science and technology documents).

However, because of a lack of strong, unified leadership, the 219 retrieval publications are compiled in a scattered way by the various information offices, so that the document records are incomplete, the disciplines are disordered, the variety is incomplete, record formats and indexing methods are not unified, and there are few types of indexes. This has made it quite difficult for scientists and technicians to find domestic or foreign science and technology documents.

To establish as soon as possible a retrieval publications system in this country, we should stress the resolution of the following few problems.

First, basic standards should be formulated for science and technology information work through scientific and technical legislation. In addition, a system for science and technology documents retrieval publications should also be worked out.

Second, the guiding ideology behind retrieval publications should be clearly established, which is that retrieval publications should serve economic construction in this country. To this end, the focus of recording science and technology documents in the retrieval publications of this country should be those production technology periodicals that are directly related to national economic construction in this country. We should pay particular attention to the needs of key science and technology projects, of the "spark plans," and of developing high technology.

Third, we should compile particular implementation plans for establishing a retrieval publications system. In 1979 the committee for editing, translation, and publication of Chinese science and technology information proposed the "Program (Draft) for the Establishment and Amplification of a Retrieval Publications System for Science and Technology Documents in This Country." This program was formulated on the basis of a long period of discussions and a wide-ranging solicitation of opinion, and the principles proposed therein still appear today to be practical and correct.

Fourth, we must formulate development plans for the retrieval of China's science and technology publications. At the 6th National Science and Technology Information Working Conference convened in 1984, the "1984-1990 Program (Draft) for the Editing, Translation, and Publication of Science and Technology Information Retrieval Publications" was studied and drawn up.

Currently, there are only 58 retrieval publications for domestic science and technology documents but 200,000 annual reports, and document databases on magnetic media have just begun to be set up. Thus, searching domestic science and technology documents is actually quite a bit more difficult than searching foreign science and technology documents. For this reason, the program's (draft) establishment of a retrieval publications system for domestic science and technology is an important task. The program (draft) also requires that a unified catalog of national science and technology periodicals and a unified catalog of national science and technology documents be organized and established as soon as possible to provide domestic accommodation for documents to ease magnetic retrieval and international on-line retrieval.

IV. The Investigative Research of Science and Technology Information

Investigative research involves an effort to analyze and study the object of research through logical thought processes that are analytical, comparative, decisive, and comprehensive, on the basis of a broad gathering and accumulation of relevant documents and materials, as well as to undertake investigation and observation when necessary, all in accordance with requirements of the task. Through investigative research we can control the rules of change that are inherent in objects and can make connections with relevant things, and consequently can propose opinions and recommendations for understanding the current situation and for forecasting future developments. Because informational investigative research has the capability to guide decision-making and to serve as a source of advice, in this country, too, it has been called a strategic information effort.

Since 1958, when China convened the first conference on the science and technology information effort, informational investigative research has developed into one of the important science and technology forces to serve the strengthening of this country's national economy. According to incomplete statistics from 1948, a total of 1,457 items of informational investigative research were accomplished by the information offices of ministries and commissions, provinces and cities in this country. This activity has become an essential major basis by which all sectors and locations of the national economy work out developmental planning for the economy and for science and technology, by which they draw up all technology policies, select technology importation projects, and carry out the exploitation of resources and project construction. It is also that by which grass-roots level industrial and mining enterprises carry out technological transformation, determine the direction of product development, and evaluate the economic results of technology.

To advance the function of informational investigative research, we should clarify the focus of the work. The national conference on the science and technology information effort convened in 1984 pointed out that informational investigative research should "continue to center on developing the strategies to open up the investigative analysis and research of information," and that informational structures at each level should "develop strategic, comprehensive, and long-range informational investigative analysis

and research in a hierarchical manner, in light of important problems in the development of the business or region in question, in order to provide informational materials and research reports for leadership decisionmaking." This principle includes the following aspects:

1. There should be a focus on the selection of topics for promoting the overall stable development of agriculture: For example, how to stabilize the production of foodstuffs, raise production quantities, increase commodity variety, and improve quality; how to speed up the development of forestry, animal husbandry, and aquaculture; and how to develop township enterprises and invigorate the rural economy. These are all important information investigative research topics.

2. We should focus on the selection of topics for expanding production of the consumer goods industry and for actively developing the civilian building industry. How to increase name-brand commodities and high quality products, and how to develop new products and new varieties or products are all major investigative research topics that could be used.

3. We should focus on the selection of topics for building the major industries of energy resources, transportation, communications, and raw materials.

4. We should focus on the selection of topics for the technological transformation of enterprises.

In addition, we should also be focusing on the selection of topics for the "spark plan" and for high technology development planning.

Presently, although there is an informational investigative research contingent in this country, the numbers are small and the quality needs improvement. According to 1982 statistics on the information offices of 41 cities, there were 259 informational investigative researchers, so that each office had on average only 6.3 people. And professionals at the mid-level or above only comprised 16 percent of the total. In addition, the intellectual organizations of informational investigative researchers are also not suited to the requirements of the current investigative research mission. Among informational investigative research personnel in this country, the great majority are science and engineering majors and are not for the most part people who have studied economics, sociology, systems engineering, or management sciences. For this reason, it can be quite a strain for them to assume some large-scale comprehensive, strategic projects, and it is hard for them to analyze and demonstrate from a point of view that combines economics, society, and science and technology.

There are two ways to resolve this problem: The first is to transfer a group of middle or high-level scientists and technicians into informational investigative research. A second would be to socialize informational investigative research, drawing on the research strengths of all aspects of society. Actually, foreign comprehensive, strategic science research units have long been this way. In recent years, many provinces and cities have also relied

upon social forces to accomplish many of their comprehensive informational investigative research tasks. A 1983 survey of conditions in Yunnan Province regarding those who are involved in projects revealed that among 87 research personnel, 41 were specialists in information, which is 47.1 percent, while social forces comprised 52.9 percent. By working in this way, the problem of the low number and low quality of informational investigative research personnal can be solved, while at the same time, the problem in which specialties are incomplete, especially where personnel are lacking in the social sciences and economic sciences, can also be solved.

V. The Current Situation Regarding Computer Information Retrieval and Its Prospects

The sharing of information resources is one of the characteristics of the development of contemporary science and technology information efforts. For information resources to be stored on computers and to be transmitted over communications satellites or by other modern means of communications has become an important index of the modernization of the information effort. Abroad, many developed countries have developed from computer storage and retrieval to the stage of international on-line information retrieval. In comparing international on-line retrieval with traditional means of retrieval, not only is the speed of retrieval faster and the efficiency higher, but there is a broader scope of retrieval and a greater quantity of documents. Searching for a subject by means of international on-line retrieval terminals generally only requires about 10 minutes. But the scope of the documents searched could reach thousands of volumes or several tens of thousands, and even millions. The period of the documents searched could be from recent years to several decades, and could even include the documents of several nations and diverse types of writing. At present, there are more than 100 large international on-line information retrieval systems in the world, more than 1,100 different databases, and more than 100 million machine-readable abstracts and indexes in storage.

Research work on computer information retrieval in this country was begun in the 1960's. During the decade from 1975 through 1985, the business of computer information retrieval in this country had a remarkable development. This has been shown chiefly in the following aspects:

1. Computer information retrieval began by importing and using foreign document magnetic media (databases). According to incomplete statistics, ministerial and commission information offices have imported 52 kinds of foreign document magnetic media, with document records totaling more than 20 million.

2. The software for computer information retrieval in this country has developed, and has gone from importing and absorption to the stage of development and innovation.

3. There have been new developments regarding the application of microcomputers in information retrieval. According to statistics, there are more than 100,000 microcomputers of various sorts being used in this

country for information retrieval. In 1984, nine dissemination projects were drawn up to provide microcomputers for information systems.

4. China has established on-line retrieval connections with some of the major information retrieval systems in the world and has begun retrieval services. In 1981, the information office of the Ministry of Railways and the information office of the Academy of Architectural Sciences proposed that, with the participation of 11 departmental offices of information, we set up international retrieval terminals in Hong Kong. In 1983, the information office of the Ministry of the Ordnance Industry remade a Siemens teleprinter and connected up with a system in the United States. In October of the same year, the China Institute of Science and Technology Information set up terminals for on-line retrieval with the United States and Italy.

Although the computer information retrieval undertaking in this country has made certain advances, there are still gaps when compared with developed countries. To speed up the process, the following efforts need to be enhanced:

1. Strengthen organization, coordinate and unify planning. We should formulate as soon as posssible the policies and planning for establishing national and professional networks of information retrieval systems. These should be implemented project by project to include the types of system, distribution. and structure and the technology line.

2. We should treat databases created through research as the primary obligation in the establishment of computer information retrieval systems. The setup of databases is the process of arranging in an orderly fashion those documents that have been collated and indexed, and storing them on magnetic media.

3. We should strengthen the designing of retrieval software. This kind of software should have very complete retrieval functions and service functions should accommodate both Chinese and foreign languages, and should especially have powerful Chinese character processing capabilities. This kind of software should also be easily transported.

4. We should augment the building of on-line international information retrieval systems and networks. To put the sharing of information resources into effect, it is not enough just to depend upon international on-line information retrieval terminals. We must also actively establish domestic public data exchange networks.

5. We should emphasize making the most of microcomputers. Presently, we should stress the organized dissemination and popularization of certain software products that have use value, and should do a good job at the pre-processing of documents and at data entry.

VI. The Training of Science and Technology Information Cadres

Science and technology information cadres should possess specialized knowledge in a particular field, should be able to read and translate foreign documents, and should be quite familiar with knowledge specific to the information field. With the development of the restructuring of the economic system and the science and technology system, the needs of society for science and technology information will become more urgent and wide ranging, but at present the science and technology information cadres in this country are far from matching their present assignments, from the viewpoint of both quantity or quality. The training of science and technology information cadres has become a major problem that is extremely urgent. Close attention should be paid to solving the following problems:

1. On-the-job training of cadres is a matter of fundamental importance to the future of the development of the science and technology information in this country, and should be included within working plans so that daily vocational activities are uniformly and completely arranged together with on-the-job training for cadres.

2. We should set up information departments or information majors at qualified comprehensive colleges and engineering institutions to be the basis for properly training professional information cadres. Colleges and universities where conditions are insufficient should do their most to add classes in scientific and technical document retrieval. These should be mandatory classes, so that after they have graduated, students can both engage in the work of science and technology information and can search for and apply domestic and foreign science and technology documents independently during research or production.

3. In cities where industries are more concentrated and where scientists and technicians are more densely populated, the science and technology information offices of the area should assume responsibility for training information customers and should disseminate the knowledge of document retrieval to improve the abilities of scientists and technicians and users as a whole to independently search for scientific and technical documents.

VII. The Restructuring of the Science and Technology Information System

For quite some time now, under the system of a planned economy the science and technology information effort has always depended upon operating expenses from the state to develop its services. There was no attention paid to making full use of its function as an economic lever, and it was separated from the supply and demand of information. Information services are passive and sealed off, lacking both pressure and motivation. With the in-depth development of the restructuring of the economic system in this country and of the science and technology system, the situation where the science and technology information system is not compatible with a planned commodity economy has become a serious problem. Building a new science and technology information system is both a requirement for the restructuring of the economic and science and technology systems, and for the development of the science and technology information undertaking itself.

The restructuring of the science and technology information system has no fixed model upon which to base itself. Restructuring itself is a process of courageous exploration, determined innovation, and a seeking for advancement. Within the restructuring there are three problems that should be dealt with properly:

A. The science and technology information effort must vigorously promote the development of a planned commodity economy.

1. We should establish a concept of the marketplace. At present, there is an urgent need by numerous farmers and township enterprises for science and technology. The need for science and technology by collective enterprises and small to medium-sized enterprises is also quite pressing. Large enterprises will quickly catch up. The need for science and technology will also become more and more urgent. For these reasons, the science and technology information sector should aim at providing information for the needs of the marketplace. They should be aware that improvements in the standards of living for the people and changes in consumption structures require a large number of products that are attractive and reasonably priced; small to medium-sized enterprises and township enterprises need "inconspicuous" technology requiring little investment but giving quick results; export commodities require improving the capacity for international competition and for generating foreign exchange; as production develops, energy conservation, water conservation, prevention of environmental pollution and protection of ecological resources all need to adopt new technologies. Technologies of these sorts are directions for service that should be respected by the science and technology information effort.

2. Face up to the economic development planning of the "Seventh Five-Year Plan," especially to major problem solving projects, to the "spark plan," and the development of high technology, and provide various informational services.

3. On the basis of providing scientific and technical information services, we should actively provide economic information, market information, and management information to satisfy the needs of the development of a planned commodity economy.

4. We should augment the analytical research aspect of information to provide advice and scientific bases for overall management and for major policy-making. In this regard we want not only to have a qualitative analysis, but also a quantitative analysis, in order to reduce and even avoid blindness in decisionmaking.

B. The science and technology information undertaking should gradually bring compensated service into effect.

There are generally two categories of information achievements: One serves overall management and major decisionmaking. This might be called a thought achievement. It can only be obtained through the exertion of great quantities of arduous intellectual effort, and is a product of the "in-depth

processing" of information. The results (use value) obtained from this kind of achievement during economic construction are always macroscopic and strategic, and of long-range significance. The other kind serves the particular economic and technical problems encountered in the areas of scientific research, production, and operations, and for the most part refers to advising services, special topic materials collection, sample volume and product service, and information reports. This kind of achievement may be called an informational achievement and also requires the expenditure of rather arduous intellectual effort, but when compared to the thought achievement could instead be called a "roughly processed" product of information.

In "Das Kapital," when Marx was discussing commodities he said: "The labor that has been expended in their production is an accumulation of the labor of mankind." This is a practical viewpoint, whether in regard to material commodities or to intellectual commodities. The two types of informational achievements discussed above are intellectual commodities created only through processing, and both are commodities of value and of use value that may be exchanged. For this reason, compensated service should be implemented for informational achievements. This can not only greatly enhance the sense of responsibility among information personnel, arousing their enthusiasm, but can also intensify the interest and capabilities of information customers for absorbing new technology information. It can also allow information providers (the seller) to meet directly with the users (the customer) in the technology marketplace, and can break through the past situation where information was ineffective and channels were not open. Because there are market regulation functions in the technology market, information providers can be urged to be intimately linked to information users by a "chain," and allows information to be able to be materialized as quickly as possible as direct production forces. We should make the most of the function of information in serving economic construction.

In recent years, compensated service has been applied to the areas of copying, translation, computer retrieval, recording, and the projection and playing of audio-visual materials. From now on, in response to the particular needs of information users, such as the collection of materials on a particular subject or of samples, the holding of exhibitions, informational investigative research, advising services, technical training, organizing domestic and foreign technical exchanges, and other intermediary services, compensated services will gradually be put into effect.

C. We should implement an expenses responsibility system for science and technology information, by which we earnestly create income and distribute it in a reasonable manner.

It was clearly provided in the "Resolution by the Central Committee Regarding the Restructuring of the Science and Technology System" that "the state will still allocate expenses for scientific and technical services related to information, standards, measurement, and observation and for organizations working in the fundamentals of technology, but through implementation of expenses responsibility systems." This makes manifest the respect and support of the government for the science and technology informational effort.

From now on, aside from the expenses allocated by the state, to hasten the development of the science and technology informational undertaking, information structures at all levels should open channels more broadly and should increase sources of funding. After implementation of compensated service for information, aside from the majority of income being used as capital for development of the information effort, we should actively establish science and technology databases, establish science and technology document retrieval publications systems, and establish computer on-line retrieval systems, as well as begin information research in certain aspects.

12586/6091
CSO: 4008/7

CHAPTER 5. LEARNED SOCIETIES

[Text] In the process of the development of modern science and technology, learned societies are the fields in which scientists and technicians can exchange information and seek the truth as well as the breeding grounds for many major inventions, discoveries, and scientific theories. During the restructuring of our science and technology system and of our drive toward socialist modernization, scientific and technical social organizations have been entrusted with the important missions of making science and technology prosper, promoting the development of disciplines, disseminating scientific and technical knowledge, training and discovering scientific and technical talent, and promoting lateral relations among science and technology and the economy.

Since 1949, there have been great developments in the scientific and technical mass organizations in China, including learned societies, associations, and symposia, all dealing with the natural sciences, the technical sciences and related disciplines and specialties, science and technology management, and science and technology dissemination. According to preliminary statistics, of the various scientific and technical mass organizations in this country, 138 are currently part of the China Science and Technology Association (CSTA), more than 100 have not yet joined, more than 300 are participants in local learned societies of science associations in the three cities of Beijing, Tianjin, and Shanghai, and there is also a large number of other local learned societies, as well as learned societies existing independently of science associations.

To summarize the activities of science and technology mass organizations, and especially the experiences of CSTA, they have studied the protection of the legal rights of S&T mass organizations during the restructuring of the science and technology system, have promoted mass S&T activities, have made the most of the positive role of the S&T mass organizations in the drive toward socialist modernization, they have kept up a socialist democracy, correctly implemented the principle of "let a hundred flowers bloom and a hundred schools of thought contend," have improved scientific and cultural standards for the entire country and its nationalities, and they have been a significant force in building socialist material and spiritual cultures.

I. The Basic Situation of S&T Mass Organizations in China

S&T mass organizations in this country were established by scientific and technical workers in accordance with the rights for free association granted to citizens by the Constitution, and are mass organizations for engaging in scientific and technical activities. These S&T mass organizations have been important positions for fostering academic democracy, initiating free exploration, promoting intellectual exploitation and the movement of personnel, expediting the development of the natural sciences and other related disciplines, and for disseminating scientific and technical knowledge. In recent years, with the development of the science and technology enterprise and the in-depth restructuring of various aspects, S&T mass organizations in this country have formed a system that is hierarchical and multifaceted.

Looking at the scope of activities, S&T mass organizations in China can be divided into either national organizations or local organizations. The following specialties exist within S&T mass organizations:

1. The natural sciences of mathematics, physics, chemistry, astronomy, geology, and biology;

2. The technical sciences and related disciplines;

3. Science and technology departments and specialties, and science and technology management and science and technology dissemination;

4. Intersecting disciplines between the natural sciences and the social sciences, and fringe disciplines.

Looking at these from the point of view of affiliation relations, they may be separated into the two mass organizations of those groups whose members are CSTA members and those who are apart from CSTA.

For reasons having to do with the systems currently in effect, the majority of S&T mass organizations in this country are closely allied with units of state organizations or facilities, and they maintain particular administrative relations with the units they depend upon. With the development of the restructuring of the science and technology system and the gradual perfecting of the legal system by the state regarding mass organizations, S&T mass organizations in this country can establish administrative relations of varying sorts with pertinent state or local departments, and can also not establish administrative relations with other departments. This way the actual situation is taken care of without obstructing the development and restructuring. The S&T mass organizations may develop to be independent legal entities that are separate from the administrative organizations.

One of the great characteristics of S&T mass organizations in this country is that the majority are members of CSTA or local science associations. Through a national scientific and technical mass organization--the CSTA, the state with its regulations has exercised management functions for the groups, and also has enhanced leadership in political ideology for the

groups through dependent units and provided support in the form of material conditions. Currently, CSTA has become a scientific and technical group composed of national learned societies, associations, symposia, and local science associations at all levels, as well as affiliated learned societies, associations, and symposia. Total membership is 1.89 million people, which is spread throughout the country and in all fields of science and technology. Of counties throughout the country and prefectural cities above the county level, 93 percent have founded science and technology associations, and more than 3,000 factories and enterprises and more than 41,000 towns and townships also have their corresponding science and technology organizations. For this reason, the work of the CSTA and its affiliated S&T mass organizations reflects the fundamental situation of S&T social groups in this country.

II. The Important Function of Science and Technology Mass Organizations

In recent years, S&T mass organizations in this country, and especially CSTA, in accordance with the principles and policies through which the state is developing science and technology, have done work in the following areas, and have played a very important role therein.

1. They have broadly initiated scholastic exchanges of all sorts, have invigorated scholastic thinking, and have explored paths for academics. Scholastic exchange activities are basic activities for scientific and technical groups. Many of the learned societies and symposia in this country have faced up to the major topics of the development of the national economy and have initiated multi-discipline comprehensive scholastic exchanges to promote the conversion of the scholastic viewpoint into the thinking involved with decisionmaking. They undertake demonstrations for work on strategies for the development of industry and agriculture, on energy resources policies, on state S&T problem solving, and on major engineering projects, and have made important recommendations toward national decisionmaking. For example, more than 20 associations of the China Agriculture Association and the Forestry Association were commissioned by pertinent national departments to provide scientific recommendations for development strategies for the Huang-Huai-Hai region, the northern semi-arid regions, and for agriculture in the Shanghai economic zone. The China Symposium on Energy Resources organized more than 500 specialists, who over a period of 3 years proposed "Recommendations for an Outline of Chinese Energy Resources," which became an important basis for formulating our energy resource policies. Science and technology mass organizations have widely exchanged and publicized new scientific and technical achievements and scholastic constructs through scholastic periodicals. There were a total of 323 scholastic periodicals in 1985 operated by national learned societies affiliated with the CSTA, with a total distribution of more than 30 million issues. Among these, 169 high-quality scholastic periodicals are distributed to more than 70 countries and regions of the world.

2. They have actively undertaken the work of disseminating science. During the "Sixth Five-Year Plan," S&T mass organizations in this country met the needs of the developing socialist commodity economy and of the restructuring of the rural economic system, and organized scientific and technical workers

to initiate rich and varied mass science popularization activities. Here, they spread and disseminated applied technologies, trained experts in specialties, and actively began science experiments and demonstration activities. S&T associations at all levels, together with their pertinent departments, started up more than 13,000 rural technology schools, which were attended by more than 45 million people. In addition, national learned societies and local S&T mass organizations edited and published 76 science popularization periodicals and 76 S&T newspapers, having periodical distribution of more than 30 million. Currently, there are 1,500 members of the national rural science and technology film brigade, and approximately half of all counties have vehicles for science popularization publicity.

3. They have vigorously initiated scientific and technical advising service activities to promote the catering of science and technology to economic construction and social development. Currently, in regard to scientific and technical advising services, S&T mass organizations in this country have formed networks, and regarding the organization of comprehensive decision-making and the provision of technical services to enterprises, they have done a great deal of work, generating definite social and economic results.

4. On many administrative levels, they have developed intellectual resources and discovered and fostered talent. Since 1980, S&T mass organizations have enabled more than 200,000 scientists and technicians to receive scientific and technical training by sponsoring lectures, training classes, and S&T institutions for advanced studies. They have offered broadcasts on "full-scale quality control," "mechanical drawing," "electronics technology and microcomputer applications," "systems engineering," and television courses, for which the audiences have reached more than 20 million people and distribution of teaching materials has been more than 6 million copies. By holding courses such as "a course on the new technological revolution," "mayor's study group," and "modern lecturers," they have allowed more than 70,000 leading cadres to gain modern scientific and technical knowledge and management knowledge. In addition to this, together with groups such as education departments, the Communist Youth League, and the Women's Federation, they have initiated various sorts of scientific and technical activities for youth. Among these, more than 40,000 elementary and middle school students have competed in youth computer programming competitions, which have received the respect and favorable comments from society.

5. They have actively begun education concerning patriotism and morality in science and technology, encouraging workers in science and technology to make the most of their intelligence and wisdom and to make contributions to the four-way modernization. S&T mass organizations in this country have several times commemorated ancient and modern foreign and Chinese master craftsmen, activities to evaluate and select outstanding essays and science popularization works, and research activities within the field of science morality. They have led scientists and technicians to dedicate themselves to science and to make more contributions to modernization. The CSTA together with the State Nationalities Commission and the Ministry of Labor and Personnel issued certificates of honor to 320,000 scientists and technicians who had worked for 30 years or more in the minority nationality regions and the frontier

regions, commending more than 2,000 advanced scientists and technicians among them.

6. They have developed scientific and technical exchanges and cooperation between peoples. At present, some of the S&T mass organizations in China have been the focus of attention regarding international cooperation in the fields of science and technology. The legal seats for the CSTA on the board of directors of the International Science Association and the World Association of Engineer's Organizations have been restored. It participates in 88 international science and technology organizations, among which 200 famous science and technology specialists have been selected as being responsible in organizations like the "Association of World Engineers," "Association of International Psychologists," "International Glass Society," "Association of International Geological Sciences," and the "International Microshaping Surgery Society." Since 1980, the CSTA has held 107 international scholastic conferences, and more than 10,500 foreign specialists have participated.

III. Policies During the "Seventh Five-Year Plan"

During the "Seventh Five-Year Plan," the activities of S&T mass organizations must put restructuring at the forefront to better suit the situation regarding internal invigoration and the open-door policy. This will allow scholastic exchanges to serve economic construction and social development, will allow the popularization of science to serve the promotion of local economies, and by hierarchically exploiting society's intellectual resources will vigorously make the most of the function of science and technology to be the cornerstone of building a modern spiritual civilization. We should focus on the following three links in our activities:

1. Actively initiate domestic and foreign scholastic exchanges to serve the promotion of advancement in science and technology.

All S&T mass organizations should be organized around the technological transformation of traditional industry, around energy resources, transportation, communications, materials, water resources, and regional development and around the comprehensive exploitation and utilization of resources. They should also focus on scholastic activities that are multi-discipline, comprehensive, and systematic, and that provide a scientific basis for leadership decisionmaking. We should focus on initiating feasibility demonstrations and analysis for the development programs, construction programs, major projects, and major technology import projects of regions and departments, for which they should obtain objective advice on decisionmaking.

2. Vigorously promote the popularization of science and technology in order to serve the promotion of local economies.

Rural science popularization efforts should be further developed to serve the promotion of rural economies. This includes such things as active accommodation with the SSTC, competent implementation of the "spark plan"

and the popularization and dissemination of model projects. We should begin to provide technical assistance to impoverished regions by showing the way, teaching technology, supporting production, and fostering talent. We should strive to help the millions of impoverished households to depend upon science and technology and break away from poverty. We should strengthen technical services in township enterprises, help tens of thousands of township enterprises realize technical advances within 5 years, and improve their economic results.

For science popularization activities in the cities, we should consider the technical promotion of small-to-medium enterprises as our strategic obligation, and should introduce talent, achievements, technology, and knowledge into the small-to-medium enterprises.

3. Exploit intellect and praise talent to serve workers in science and technology as they unfold the great plan.

We should actively develop continuing education for scientists and technicians and cater to scientific and technical training in society. We should establish a working system with a fixed time for the recommendation of talent to the state, compile and publish records of outstanding talent, broadly publicize the accomplishments of outstanding scientists and technicians, propose suggestions of a policy nature, set up reward funds, and create the conditions for the advanced studies of top-notch talent.

IV. Restructure Work in Management and Allow S&T Mass Organizations To Play Their Part

The work of S&T mass organizations is an important component of China's science and technology effort. To carry out thoroughly the strategic principle whereby science and technology efforts cater to economic construction and to realize the grand goals of the "Seventh Five-Year Plan," we must make full use of S&T mass organizations in making science prosper, in promoting lateral relations between science and technology and the economy, and in advancing the progress of technology. To this end, we should restructure management efforts regarding S&T mass organizations.

S&T mass organizations are groups freely formed and organized by workers in science and technology in accordance with the laws of the state. S&T mass organizations are not the same as state organizations, institutions, or factories and enterprises. The state has provided guidance for S&T mass organizations in the form of principles and policies. We will actively restructure regarding the management system, will pay attention to using legal means to replace administrative means, and will make full use of the potential for S&T mass organizations to explore the unknown worlds of science and technology and to serve state decisionmaking and economic construction. We must be careful to abide by the following principles:

A. We must implement the principles of "letting a hundred flowers bloom, letting a hundred schools of thought contend," praising scholastic democracy, respecting scholastic freedom, promoting free exploration, encouraging and

supporting the fearless probing for scientific truth by S&T mass organizations and scientists and technicians, and encouraging S&T mass organizations and scientists and technicians to promote developments in each discipline through free debate, by learning from one another, and through mutual enlightenment.

B. Through the active guidance that science policies, technology policies, and development strategies exercise on S&T mass organizations, we must attract the participation of S&T mass organizations in state activities such as S&T project debates, S&T achievement appraisals, professional duties and rank evaluation, reading and editing of science documents, and the formulation of technical standards. We should encourage the organizations and their workers in science and technology to make important contributions to the undertaking of science and technology. We must initiate a scholastic spirit of self-dedication, innovation, realism, and cooperation and strengthen the capacities of S&T mass organizations to serve the building of socialist material and spiritual civilizations. We should enhance the attractiveness and cohesiveness of organizations to scientists and technicians and strengthen the vitality of organizations regarding self-perfection and self-development.

C. Through legislation, we should clarify the legal positions of S&T mass organizations, ensure their legal rights and interests, and prescribe their basic authority and duties to allow them to become independently-existing scholastic principals.

S&T mass organizations in this country are legal social entities. The scientific and technical activities undertaken by organizations in accordance with national laws and the rules of organizations are protected by the state. S&T mass organizations may engage in the following scholastic activities. No unit or individual may illegally interfere with:

1. Determining the direction and content of scholastic activities;

2. Organizing scholastic research and exchanges;

3. Issuing scholastic papers, and editing and publishing books and periodicals;

4. Holding scholastic annual meetings, conferences, public lectures, and exhibitions;

5. Holding classes for advanced studies, training classes, and public lectures for the popularization of science;

6. Providing scientific and technical advising and services.

In accordance with the actual practice of restructuring the science and technology system, S&T mass organizations in China should share the following rights:

1. Within the scope provided by national laws, organizations may accumulate funds, accept domestic and foreign contributions, gift funds, subsidies, and other monetary gifts. legally share the rights to ownership of property, and can also obtain fixed capital from pertinent state departments or units in keeping with agreements, and may legally share the rights to usage of property.

2. Organizations may have copyrights, patents, and trademark rights on their scientific and technical achievements, as well as other knowledge product rights.

3. Organizations may make contracts with other organizations and individuals regarding activities such as science and technology research, technology development, the transfer of rights to technology, and technical services, and may obtain legal income therefrom. This legal income is exempt from business taxes and income taxes in light of state provisions regarding science research institutions.

4. Organizations may develop scientific and technical cooperation and scholastic exchanges internationally or with foreign science and technology organizations and individuals in accordance with pertinent state regulations, and may apply for admission to international scholastic organizations, and admit members who are foreign citizens.

Correspondingly, S&T mass organizations should also assume necessary obligations:

1. Organizations should carry on their activities in accordance with national laws and the provisions of the organization's constitution, should promote the development of science, popularize scientific knowledge, discover and train scientific and technical personnel, and may not engage in operational activities that are not concerned with science and technology.

2. Organizations should turn over annual work reports each year to science and technology administration departments, providing recommendations and opinions for the modernization of national science and technology.

3. Organizations should enthusiastically assume and fully complete the duties of science research, technology development, and scientific and technical advising services as commissioned by state or local organizations, institutions, enterprise units, and other organizations, and should actively serve the progress of science and technology and social development.

4. Organizations should maintain a socialist orientation, promote spiritual civilization, initiate education in science morality, and unceasingly improve the political and ideological quality of S&T contingents.

5. When organizations make public the discoveries and inventions of science and technology and major S&T achievements, as well as data and materials that involve national secrets, they should obtain the agreement of S&T administrative departments.

D. Perfect the registration system for S&T mass organizations, and enhance the management of these organizations.

It was only in September 1950 that the Central People's Government issued the "Provisional Laws for Mass Organization Registration," but many of the provisions therein are out of date. Because of legislation regarding organizations in this country, including long time voids in laws regarding entities and procedural law, and even because procedures and formalities for the establishment of mass organizations have not been clear and rights and obligations have not been clear, management efforts cannot suit the needs of the restructuring. On the one hand, the great advantages and potential of the majority of S&T mass organizations and their functions have not been fully utilized, and on the other hand, because a minority of organizations have been fraudulent, even violating their constitutions, illegal business engagements have not been promptly corrected and halted. In September 1985, the State Commission on the Restructuring of the Economic System clearly required that from then on, approval would have to be sought of the SSTC for the establishment of national mass organizations having to do with the natural sciences. Currently, the SSTC is drafting the "S&T Mass Organization Law (Draft)" together with organizations such as the CSTA and the Chinese Academy of Sciences. It is providing the conditions for the establishment, modification, and termination of S&T mass organizations and the legal positions of application, approval, and registration organs and organizations, and is as well providing a reward and punishment system relevant to the work of mass organizations, based on the principles of a respect for knowledge and for talent.

Management efforts for S&T mass organizations in this country will eventually get onto the right legal track. S&T mass organizations will make even more contributions to the cause of the vigorous development of China, the realization of the Four Modernizations, and the building of a socialist state that is highly democratic and highly enlightened.

12586/6091
CSO: 4008/7

PART VI. STATISTICAL INDICATORS

STATISTICAL INDICATORS

[Text] The figures in this section have been edited and compiled in part from the 1985 national S&T survey. This survey covered only R&D in the fields of physical science, engineering, agriculture and medicine. It did not include social science organizations, nor R&D organizations in education, industrial enterprises, or the national defense establishment.

Within these parameters, at the end of 1985, this was the general situation of organizational and personnel activities:

Of those organizations engaged in scientific research and technological development (hereinafter referred to as R&D organizations) which are subordinate to governmental bodies in China above (but not including) the county level, there were 4,690 such organizations. These had a total of 770,000 staff, of which 231,000, some 30 percent of the total, were scientists and engineers. (This refers to those who have either completed college at the undergraduate level or above, or are S&T personnel with an educational level equivalent to senior middle school.)

There were 3,268 R&D organizations subordinate to county level governmental bodies, with 77,000 employees. Of the latter, 4,960 had an educational level above undergraduate college, 6.4 percent of the total.

Nationally, 32 percent of the R&D organizations above the county level had implemented the technology contract system. Of these, 317 achieved economic independence, and 640 reduced operating expenses.

In 1985, 73,000 organizations above the county level began R&D projects; these involved 243,000 employees and 1.81 billion yuan in funds (exclusive of expenses for personnel, administration, capital construction, fixed assets, etc.).

Some 24 percent of the R&D organizations above the county level set up regular joint operations with enterprises, and 22 percent established regular technical consulting relationships with enterprises.

R&D organizations above the county level transferred technology valued at 780 million yuan in 1985.

CHAPTER 1. INSTITUTIONS AND PERSONNEL

[Text] 1. R&D Institutions and Personnel Above the County Level

There are 4,690 scientific research and technological development organizations (hereinafter referred to as R&D organizations) which are subordinate to governmental bodies in China above the county level. (Footnote 1) (That is, R&D organizations reporting to governmental bodies at the level of municipality or above.) These organizations employ 770,000 personnel, of which 231,000 are scientists and engineers (Footnote 2) (By "scientists and engineers" is meant S&T personnel who have an educational level equivalent to a college undergraduate degree or higher, as well as other S&T personnel who have a senior middle school level education), or 30 percent of the total.

Some 84 percent of the R&D organizations are subordinate to provinces, autonomous regions or central-government-controlled municipalities. Although R&D organizations directly subordinate to the Chinese Academy of Sciences constitute but 2.6 percent of the total, still their total number of scientists, engineers or similarly-classed personnel is 13.9 percent of the total (see Figure I-1 and Table I-1).

Subordinate relationships

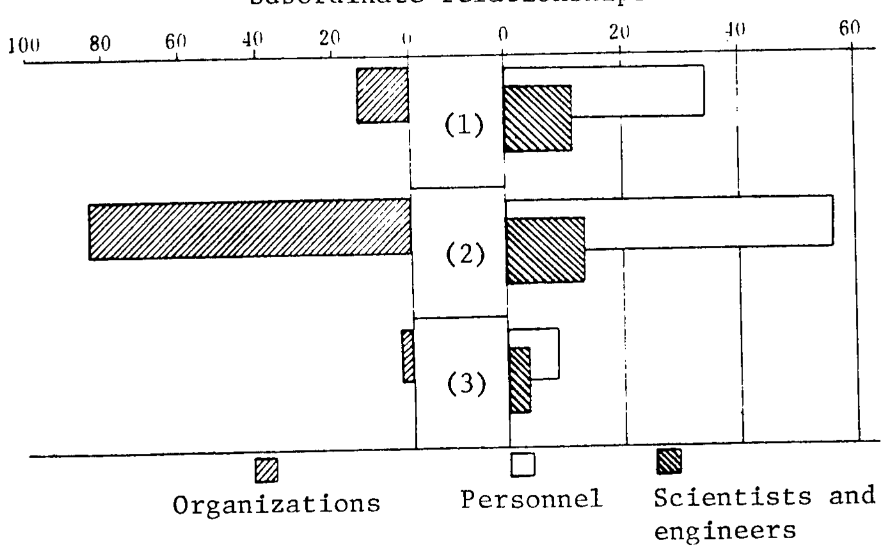


Figure I-1. Distribution on Basis of Subordination (%)

[Key on following page]

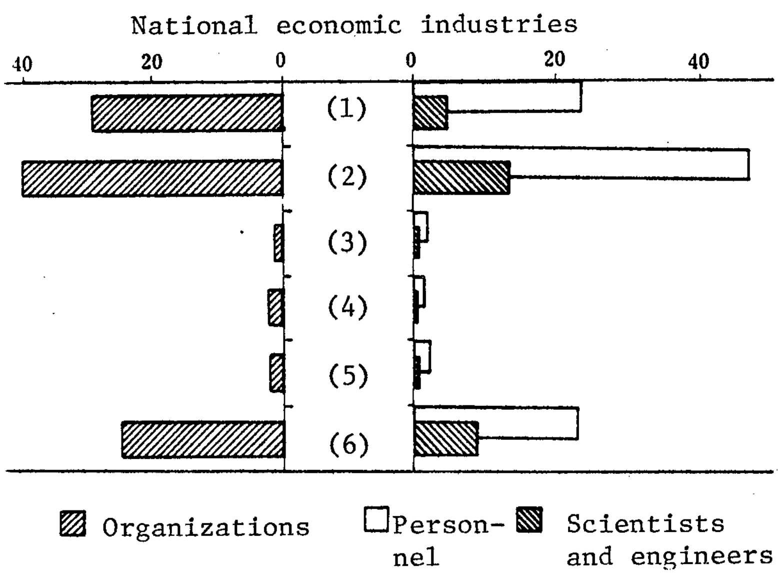
Key:

(1) Subordinate to departments of the State Council
(2) Subordinate to provinces, autonomous regions, and central-government-controlled municipalities
(3) Subordinate to the Chinese Academy of Sciences

Table I-1. Distribution on Basis of Subordination

	Number of organizations (each)	Number of personnel (each)	Personnel in S&T activities (each)		
			Total	Scientists, engineers included in total	Other S&T personnel included in total
Grand total	4,690	770,416	575,736	231,050	121,000
Sub. to depts. of State Council	622	266,412	204,370	93,026	36,787
Sub. to provinces, autonomous regions, and government-controlled municipalities	3,946	434,354	313,146	105,850	75,385
Subordinate to CAS	122	69,650	58,220	32,174	8,828

When the division is made on the basis of national economic industries, the most numerous R&D organizations are those engaged in industry, or in agriculture, forestry, animal husbandry, fishing and water conservancy. These constitute 40 percent and 29 percent of the national total respectively. The corresponding organizations' personnel figures are 47 percent and 24 percent of the national figure for R&D organizations. The greatest number of scientists and engineers are in R&D organizations of industrial enterprises, 45 percent of the national total for similar positions in R&D organizations nationally. (See Figure I-2 and Table I-2)



Key:

(1) Agriculture, forestry, animal husbandry, fishing, water conservancy
(2) Industry
(3) Geological survey, exploration
(4) Construction
(5) Communications and transportation, posts and telecommunications
(6) Other

Figure I-2. Distribution on Basis of Industries in the National Economy (%)

Table I-2. Distribution on Basis of National Economic Industries

	Number of organizations (each)	Number of personnel (each)	Personnel in S&T activities (each) Total	Scientists, engineers included in total	Other S&T personnel included in total
Grand total	4,690	770,416	575,736	231,050	121,000
Agriculture, forestry, animal husbandry, fishing, water conservancy	1,377	182,364	115,430	37,799	21,219
Industry	1,882	361,067	278,132	104,559	55,696
Geological survey, exploration	61	15,732	12,861	7,048	2,521
Construction	103	13,786	11,295	5,089	2,596
Communications and transportation, posts and telecommunications	98	19,371	16,326	7,602	3,541
Other	1,169	178,096	141,692	68,953	35,427

The degree of concentration of R&D organizations and their scientists and engineers is clearly delineated by geographic region. The largest number of R&D organizations is in east China, 28 percent of the total. While only 18 percent of the national total of R&D organizations is found in north China, still 33 percent of the scientists and engineers are concentrated in this region. On the average, southwest and northwest China each have approximately 10 percent of the national total of R&D organizations and of scientists and engineers. (See Figure I-3 and Table I-3)

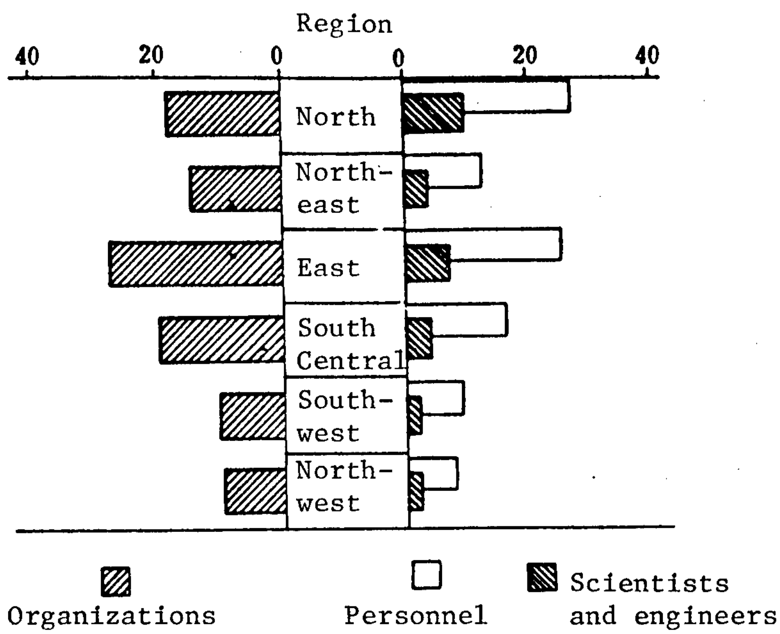


Figure I-3. Distribution by Region (%)

Table I-3. Distribution by Region

	Number of organizations (each)	Number of personnel (persons)	Personnel in S&T activities (persons)		
			Total	Scientists, engineers included in total	Other S&T personnel included in total
National total	4,690	770,416	575,736	231,050	121,000
North China	848	210,637	158,938	75,354	30,204
Northeast China	686	99,579	73,037	29,842	15,987
East China	1,291	197,336	151,080	56,545	32,494
South Central China	930	127,344	92,886	32,631	19,404
Southwest China	481	71,836	52,610	18,416	12,132
Northwest China	454	63,684	47,185	18,262	10,779

The majority of R&D organizations having staffs of more than 500 persons are concentrated in departments of the State Counil, and they comprise more than half of the R&D organizations nationally of that size. The R&D organizations having fewer than 50 persons on their staff are concentrated in provinces, autonomous regions and central-government-controlled municipalities, and they comprise 97 percent of the national total for R&D organizations of that size. (See Figure I-4, Tables I-4 and I-5)

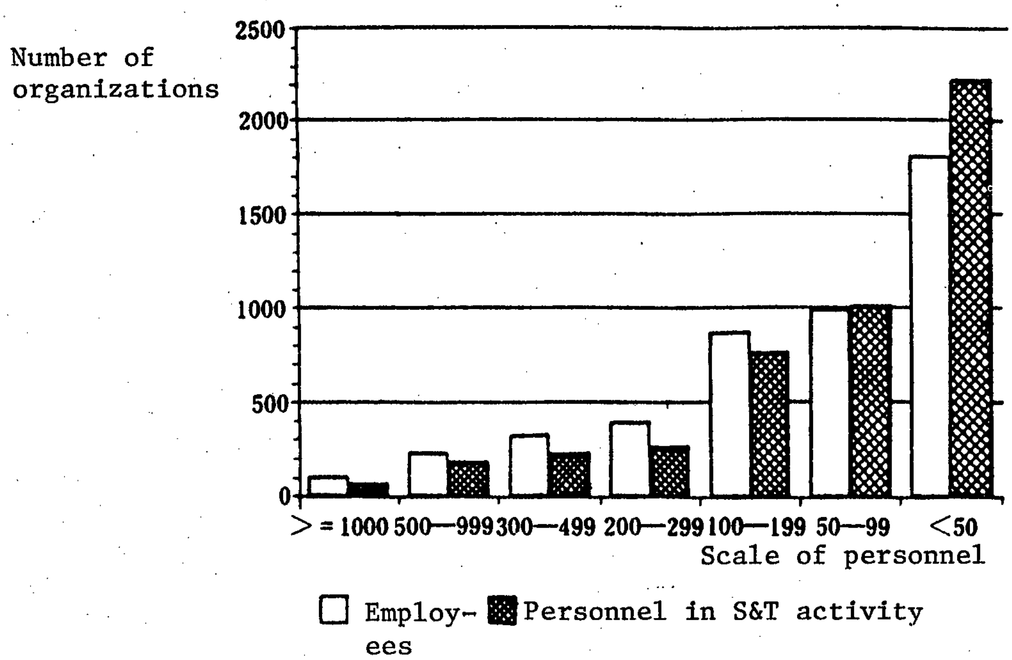


Figure I-4. Organizations by Size of Staff Engaged in S&T Activity

Table I-4. Organizations by Size of Staff (Unit: persons)

	Total orgs.	>= 1000 pers.	500 —999 pers.	300 —499 pers.	200 —299 pers.	100 —199 pers.	50 —99 pers.	< 50 pers.
National total	4690	102	229	316	392	868	982	1801
Sub. to departments of State Council	622	62	120	116	74	110	79	61
Sub. to prov., auto. regions, municipalities	3946	22	75	171	303	740	895	1740
Subordinate to CAS	122	18	34	29	15	18	8	0

Table I-5. Organizations by Size of Staff Engaged in S&T Activity (Unit: individual)

	Total orgs.	>= 1000	500 —999	300 —499	200 —299	100 —199	50 —99	30 —49	20 —29	10 —19	1 — 9
National total	4690	60	176	221	258	753	1008	703	500	661	350
Sub. to State Council	622	37	106	96	79	127	99	46	15	11	6
Sub. to prov., auton. regions, municipalities	3946	9	45	89	163	606	900	655	485	650	344
Subordinate to CAS	122	14	25	36	16	20	9	2	0	0	0

At the end of 1985, 32 percent of R&D organizations nationally had implemented the technology contract system. Of these, 317 had achieved economic independence, while 640 had decreased their operating expenses (see Figure I-5 and Table I-6).

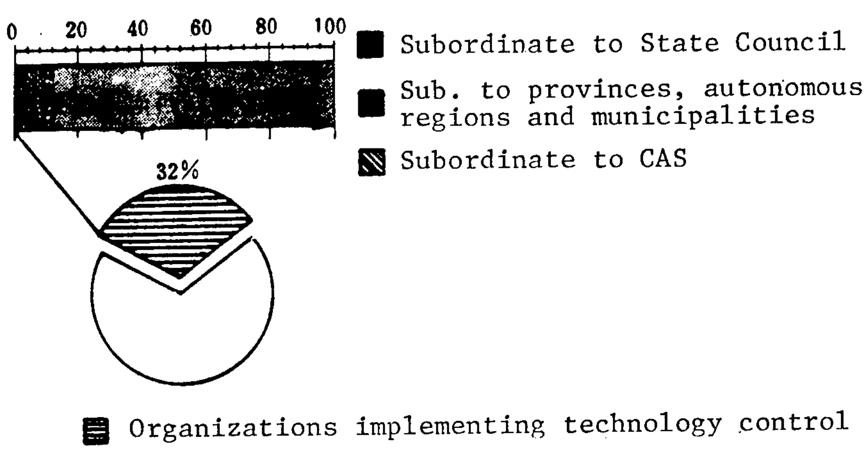


Figure I-5. Organizations Implementing the Technology Contract System (in percent)

Table I-6. Organizations Implementing the Technology Contract System (Unit: individual)

	Total organizations	Number of organizations implementing technology contract system	Economically independent organizations in item 2	Organizations in number 2 which decreased expenses
National total	4,690	1,499	317	640
Sub. to State Council	622	184	39	87
Sub. to prov., auto. regions and municipalities	3,946	1,315	278	553
Subordinate to CAS	122	0	0	0

2. R&D Organizations and Personnel at the County Level

Nationally there are 3,267 R&D organizations subordinate to government departments at the county level, having 77,000 employees. The majority of these have been put into agriculture, forestry, animal husbandry, fishing and water conservancy (see Figure I-6 and Table I-7).

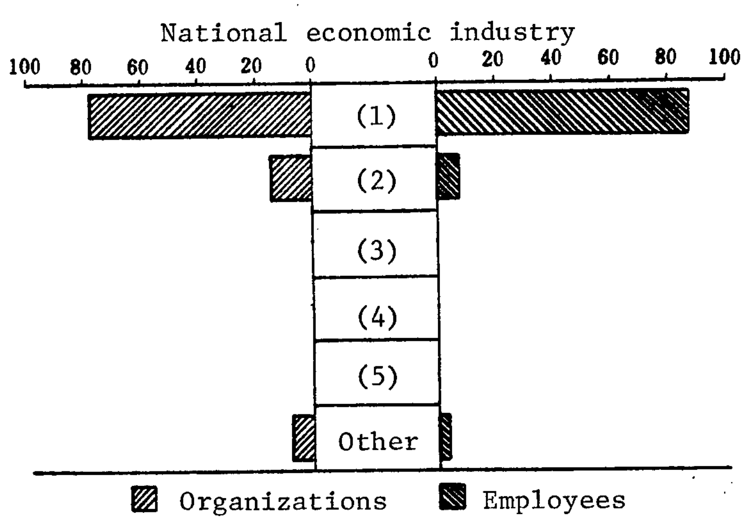


Figure I-6. Distribution on Basis of Sector of the Economy (%)

Key:
- (1) Agriculture, forestry, animal husbandry, fishing, water conservancy
- (2) Industry
- (3) Geologic survey and exploration
- (4) Construction
- (5) Communications and transportation, posts and telecommunications

Table I-7. Distribution on Basis of Sector of the Economy (%)

	Total	(1)	Industry	(2)	Construction	(3)	Other
Total organizations	3267	2524	469	3	12	4	255
Total employees	77435	67782	6268	15	280	60	3030

Key:
- (1) Agriculture, forestry, animal husbandry, fishing, water conservancy
- (2) Geological survey, exploration
- (3) Communications and transportation, posts and telecommunications

In staff size, these organizations are, on the average, quite small. The smallest average size organizations are found in southwest and northwest China, where the average staff size is only 13 persons (see Table I-8).

The greatest number of organizations and staff are found in the south central region of China, while the fewest are found in the southwest (see Figure I-7, Table I-8).

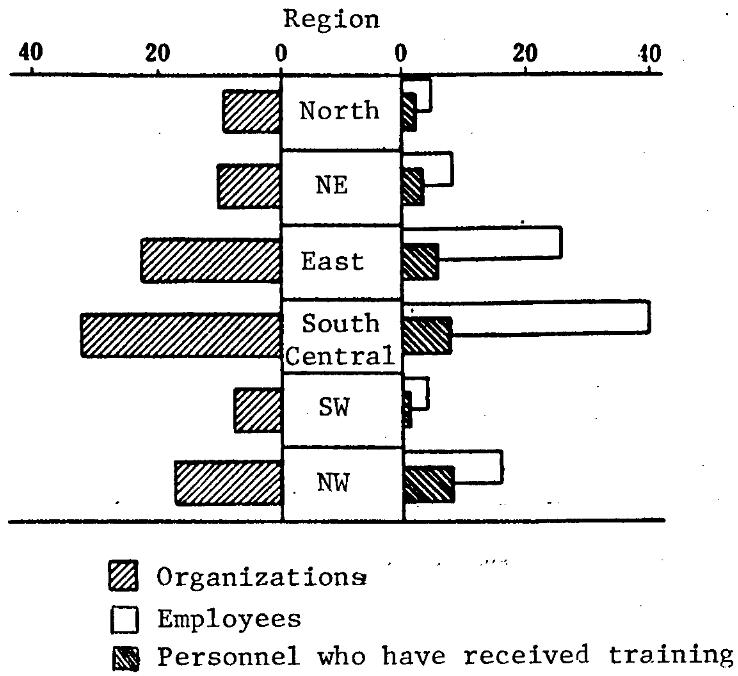


Figure I-7. Distribution by Region (%)

The number of employees at this level who have received specialized training is relatively small. (By this is meant those personnel who have had training at the level of technical school or above.) The highest proportion is in northwest China, with 50 percent, and the smallest in south central and east China, with about 20 percent (see Table I-8).

Table I-8. Distribution by Region

	(1)	(2)	Educational level (persons)			
			(3)	(4)	(5)	Other
(6)	3267	77435	4961	3876	13405	55193
North	307	4010	392	381	1093	2144
Northeast	341	6548	732	521	1443	3852
East	741	20048	1288	828	2387	15545
South-central	1055	30984	1295	1164	3562	24963
Southwest	256	3343	289	169	542	2343
Northwest	567	12502	965	813	4378	6346

Key:

(1) Total number of organizations
(2) Total number of employees
(3) University graduate and above
(4) Some college or university training
(5) Technical school
(6) Total for provinces, municipalities, autonomous regions

12625/6091
CSO: 4008/7

CHAPTER 2. INSTITUTIONAL ACTIVITIES

[Text] The material contained in this chapter deals with S&T activities in R&D organizations subordinate to government departments above the county level.

1. Investment in Projects (Personnel and Expense)

In 1985, R&D organizations initiated 73,000 projects, employing 243,000 people. The total outlay of direct expenses invested in these projects was 1.81 billion yuan (exclusive of such expenses as personnel, administrative costs, capital construction and fixed assets). When a comparison is made of the average investment per project (people and money) on the basis of parent agency (i.e., reporting to a province, autonomous region or directly-administered municipality, or to the State Council, or to the Chinese Academy of Sciences), it is found that the ratio of these three bodies is 1:2.1:1.7 and 1:1.6:2.8 respectively. The average per-project investment in resources was highest in those R&D organizations which report to the CAS, followed by those under the State Council. (See Figure II-1-1)

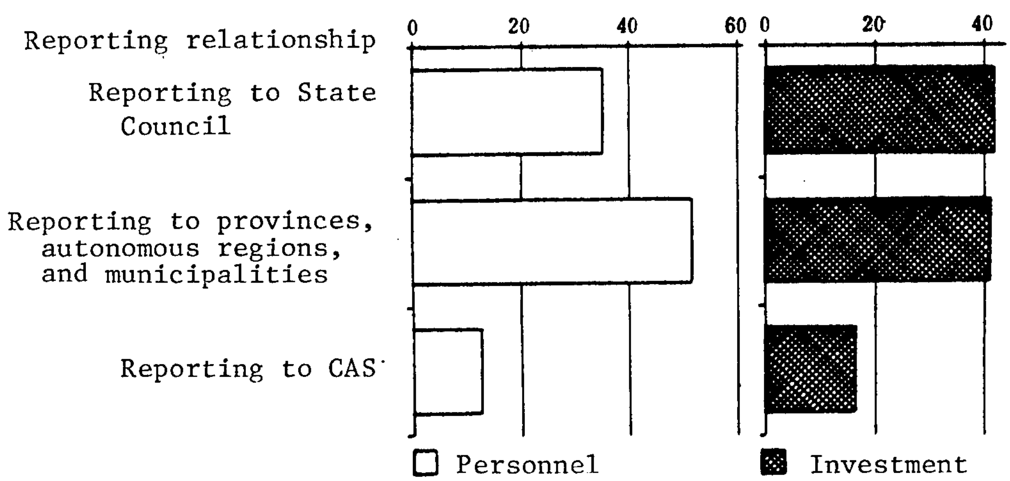


Figure II-1-1. Distribution on Basis of Reporting Relationship (%)

The types of projects in R&D organizations show some obvious differences in concentration by area when looked at from the standpoint of the organizations' reporting relationships. Examined from the standpoint of funds invested in projects, it is evident that the large-scale comprehensive R&D organizations under the Chinese Academy of Sciences have a high concentration of basic and applied research, while testing and development tends to be concentrated in those organizations which report to the State Council. Such activities as engineering and design, popularization and service, or production-type activities are found for the most part in the R&D organizations which report to provinces, autonomous regions, or directly-administered municipalities. (See Figures II-1-2 and II-1-3)

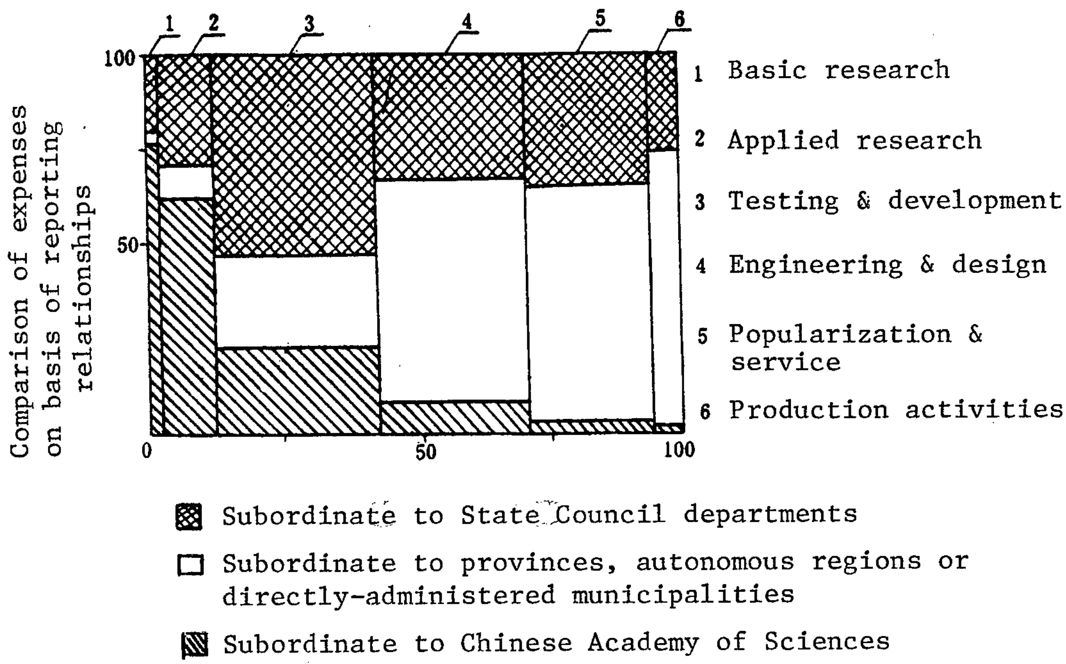


Figure II-1-2. Investment by Class of Project (Expenses) With Distribution on Basis of Reporting Relationship (%)

There is an extensive spectrum of projects in China's R&D organizations. It covers both basic and applied research, testing and development (that is, R&D activities), while also encompassing engineering, design, popularization and service, and other, production-type activities. This covers a total process, from scientific research to direct application.

The ratio of projects classed as R&D activities compared to other types of activities is 1:2.4.

Investment in projects serving social and economic areas (objectives) generally reflects the concentration of R&D activities in advancing development in the areas of industry, agriculture, forestry and fishing. (See Figure II-1-4)

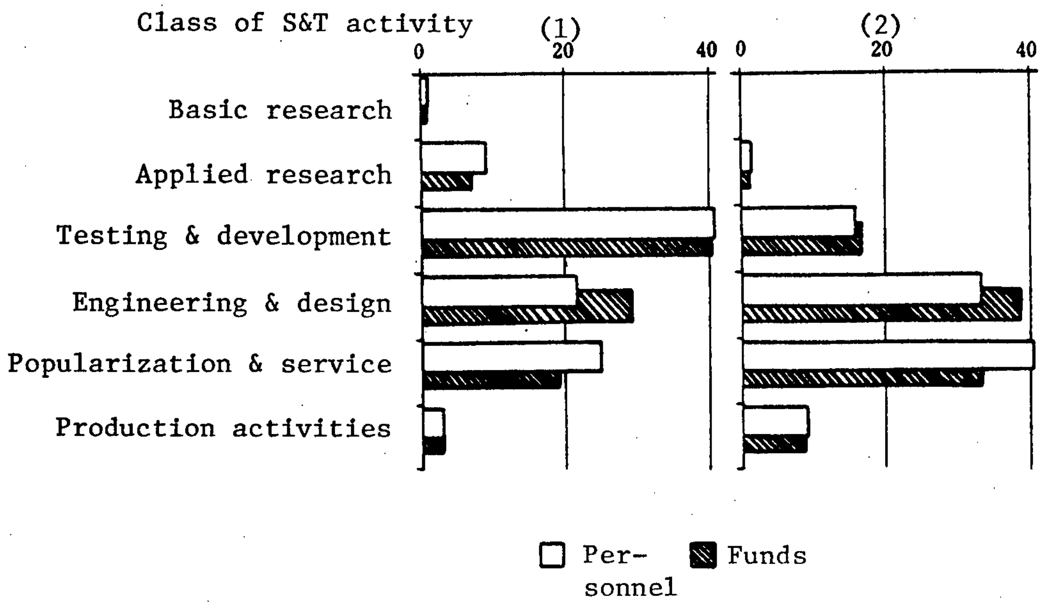


Figure II-1-3. Distribution by Reporting Relationships (%)

Key:
(1) Subordinate to State Council departments
(2) Subordinate to provinces, autonomous regions and directly-administered municipalities

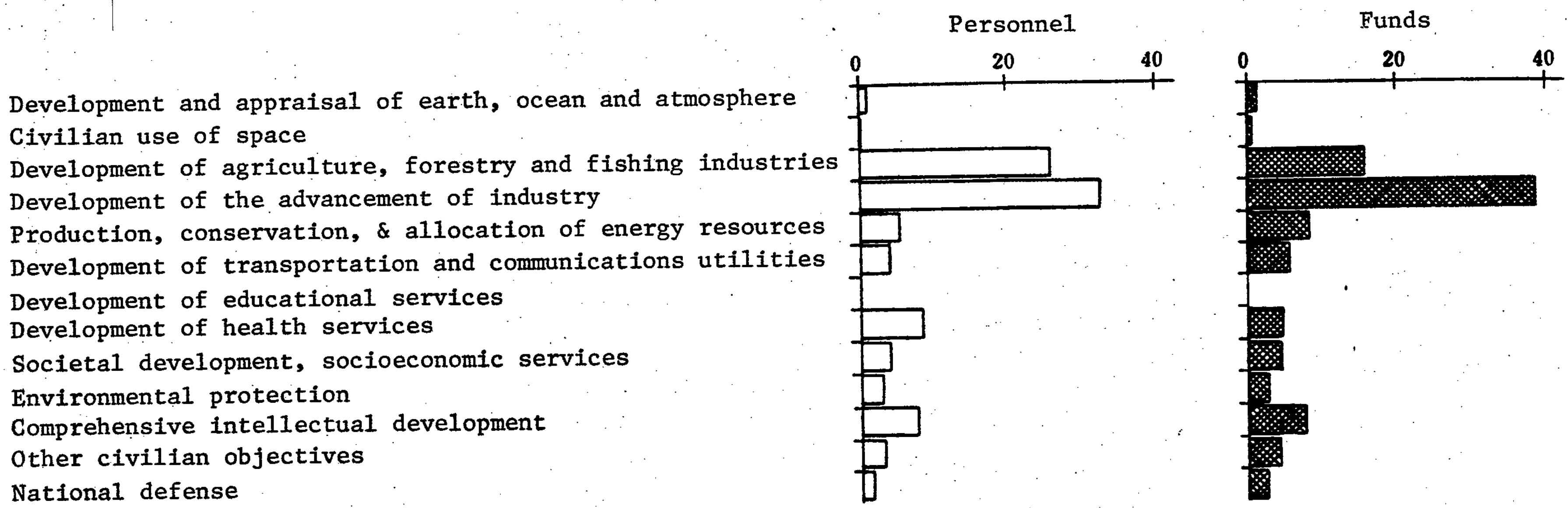


Figure II-1-4. Distribution on Basis of Social and Economic Objectives (%)

2. The Pattern of Relationships With Enterprises

Reform of the S&T system has pushed this work in the direction of economic construction: 24 percent of the R&D organizations have established regular relationships with enterprises which are based on R&D work, and 22 percent of these organizations have regular consulting relationships. We see particular emphasis on these two relationship patterns in those R&D organizations which are subordinate to the State Council, and in those reporting to provinces, autonomous regions and directly-administered municipalities. (See Figure II-2-1)

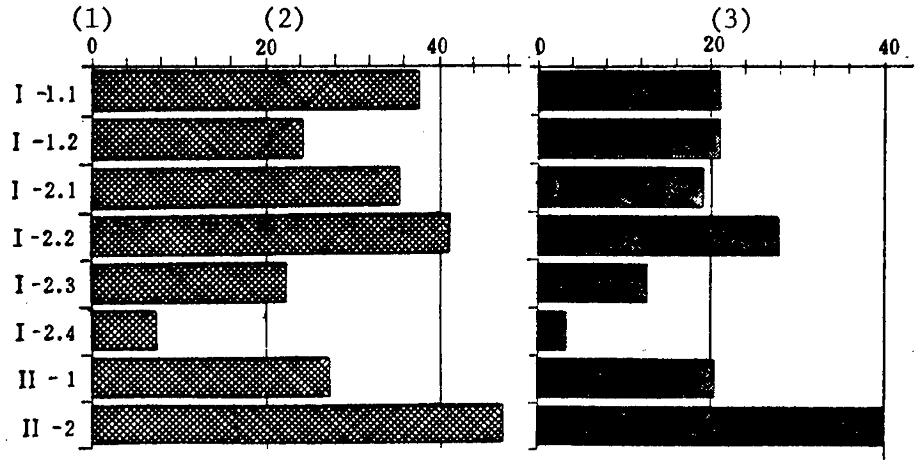


Figure II-2-1. Distribution on Basis of Pattern of Relationships With Enterprises (%)

Key:
- (1) Pattern of relationships with enterprises
- (2) Departments subordinate to the State Council
- (3) Subordinate to provinces, autonomous regions, and municipalities

Note: The national pattern of S&T relationships between R&D organizations and enterprises breaks down into the following:

I: Regular (often legalized) relationships:

I-1.1: Those which take the R&D organizations' work as a guide, with the production unit (the enterprise) assuming overall responsibility for trial-manufacturing and production, in accord with a mutually agreed-upon project plan.

I-1.2: Those which are guided by the management goals of the production unit (the enterprise), with the R&D organization obligated to provide such services as consultation, training and testing on a long-term basis.

1-2.1: Directing transfer of results.

I-2.2: Directing the professional missions of technological consulting, training, etc.

I-2.3: Joint capital, joint mission, investment, joint management of the development of a product or technology.

I-2.4: Joint capital, mission, investment and management of an industry or business.

II: Having the marketplace as the key factor:

II-1: The R&D organizations make regular market analyses, and plan their activities on the basis of the marketplace, with clear-cut consumer and mission targets.

II-2: The R&D organizations plan their activities on their own, then look for consumers after results are attained.

3. Technology Transfer

In 1985, the volume of business in technology transfer by R&D organizations reached 780 million yuan. Those R&D organizations subordinate to the State Council showed the greatest potential for technological development, with other organizations contributing but 13 percent of the national total. (See Figure I-1) However, in technology transfer, the volume of business from these other organizations amounted to 50 percent of the total. (See Figure II-3-1)

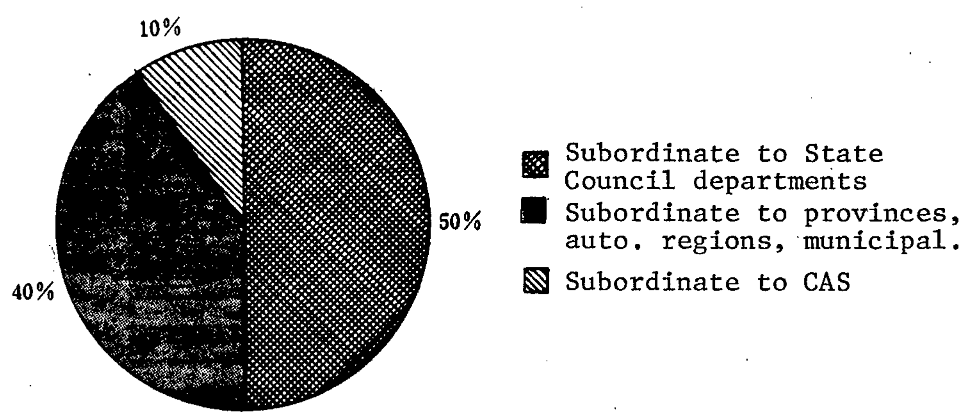


Figure II-3-1. Distribution of Volume of Business on Basis of Reporting Relationship (%)

The orientation of types of transfer received in this volume shows a difference among R&D organizations on the basis of their reporting relationships. These differences are chiefly along the lines of each having its own emphases. Large and medium-sized enterprises which are owned by the people as a whole did 51 percent of the total volume of business. Of this,

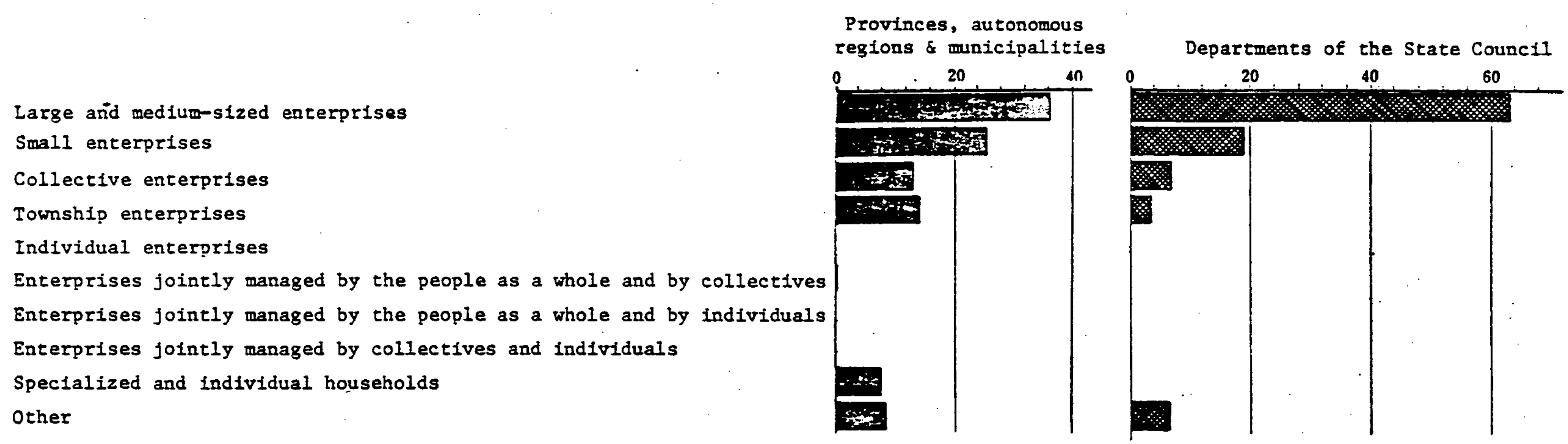


Figure II-3.2. Distribution of Volume of Business on Basis of Orientation of Transfer Received (%)

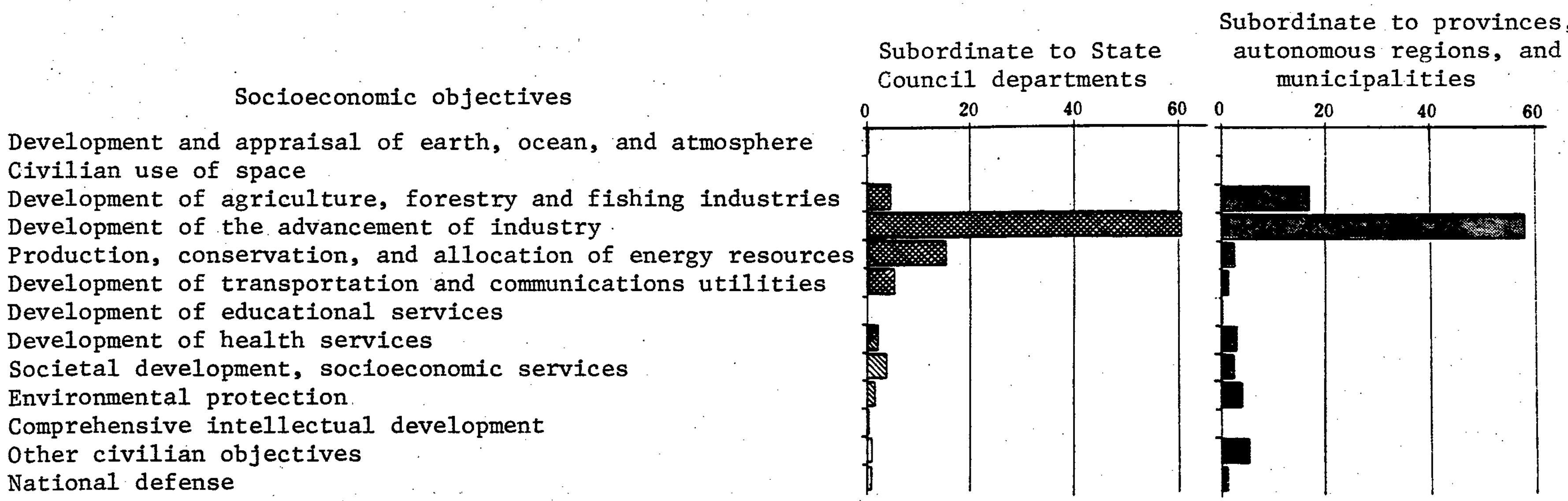


Figure II-3-3. Volume of Business Distributed on Basis of Socioeconomic Objectives (%)

63 percent was supported by organizations which are under the State Council, with a smaller volume of business done by collective and village enterprises; of the latter, the majority was supported by organizations reporting to provinces, autonomous regions and directly-administered enterprises. (See Figure II-3-2)

Nearly 58 percent of the transferred technology was used to advance development of enterprises. R&D organizations under the State Council did the largest volume of business which advanced the development of enterprises and developed energy resources. R&D organizations which report to provinces, autonomous regions and directly-administered municipalities had a large share of the volume which was used to advance development of agricultural, forestry, animal husbandry, fishery and irrigation enterprises. (See Figure II-3-3)

12625/6091
CSO: 4008/7

END